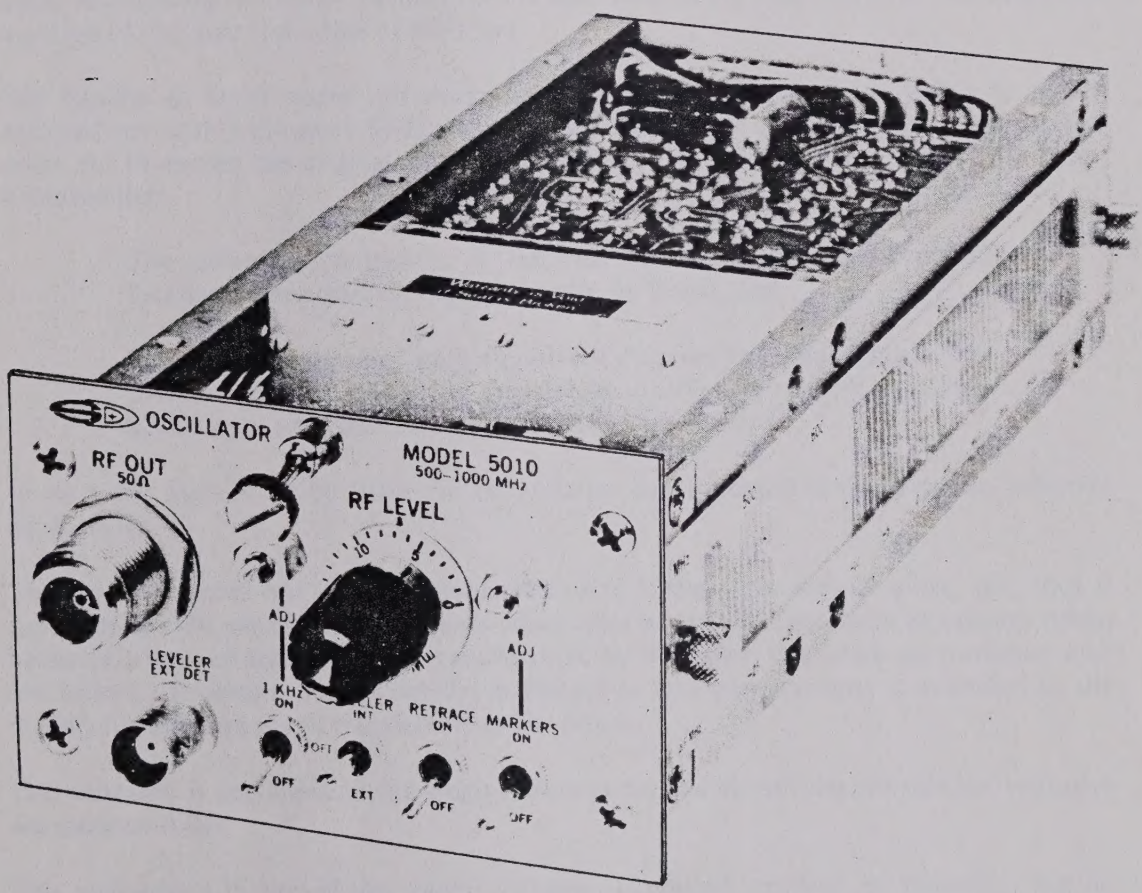
5010

OPERATION AND SERVICE MANUAL



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SYSTRON DONNER CORPORATION
ONE SYSTRON DRIVE
CONCORD, CALIFORNIA 94518 USA

RF PLUG-IN UNIT

MODEL 5010

500 TO 1,000 MHz

MICROWAVE DIVISION
SYSTRON DONNER CORPORATION
TEST AND MEASUREMENT GROUP

PRINTED January 11, 1979
MANUAL P/N 95079106

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CORPORATION

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SECTION I

GENERAL INFORMATION

1-1. SCOPE

This manual provides general information, installation data, operating instructions, circuit descriptions, maintenance data, performance checks, calibration procedures, parts lists, and circuit diagrams for the Systron-Donner (Microwave Division) Model 5010 RF Plug-in.

The Model 5010 RF Plug-in Unit, hereinafter referred to as the Model 5010, the plug-in, or the unit, is shown in Figure 1-1 installed in a Model 5000A Sweeper Mainframe. Instructions for operation and service of the mainframe are contained within a separate manual.

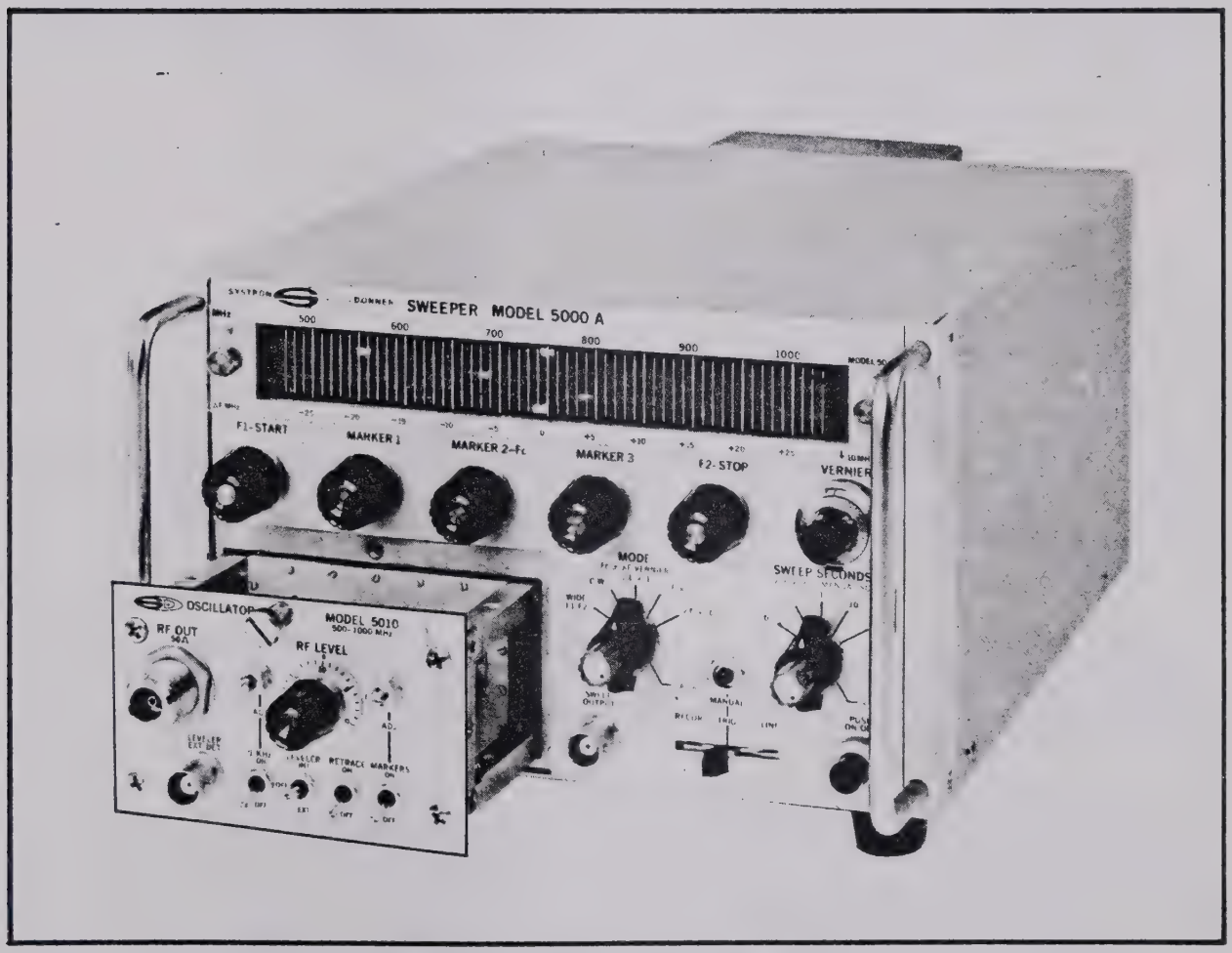


Figure 1-1. Model 5010 RF Plug-in

1-2. DESCRIPTION OF EQUIPMENT

The Model 5010 operates over the frequency range of 500 to 1,000 megahertz; its output may be swept in either direction over all or any portion of this range, amplitude or frequency-modulated, or utilized as a frequency-agile RF source in systems operation.

The plug-in is supplied with a plastic dial scale calibrated for the 5010's usable frequency range of 470 to 1,030 megahertz. This dial scale is installed in the Model 5000-series mainframe at the time the 5010 is installed. Dial scales are available separately for use with other compatible mainframes.

Major subassemblies of the 5010 include a linearizer board, a leveler/amplitude modulator board, an optional power meter leveling board, an optional fast A.M. board, a solid-state oscillator module, an optional internal directional detector, and several chassis-mounted control switches and potentiometers.

1-3. CAPABILITIES AND PERFORMANCE

The Model 5010 plug-in, used within an appropriate mainframe, is intended for use in laboratory and field tests of electronic communications components, subsystems, and systems by offering a precisely-calibrated alternative to time-consuming point-by-point testing of amplitude versus frequency characteristics over wide ranges. The frequency range includes the major portion of the UHF (ultra-high frequency) band (current JCS band designation "C"). This range encompasses several communications bands, aircraft navigation aids, and UHF television broadcast bands.

Detailed performance specifications for the plug-in are given in Table 1-1.

Salient features of the unit are summarized in the following paragraphs.

1-3.1 External Power Requirements

All required power is supplied by the mainframe in which the 5010 is installed.

1-3.2 Frequency Range

The Model 5010 uses a fundamental-frequency voltage-tuned high-frequency oscillator to cover the octave range of 500 to 1,000 megahertz. Operating and marker frequencies are indicated by colored pointers over the frequency scale of the mainframe. Dial accuracy is plus or minus five megahertz.

1-3.3 Mainframes

The 5010 RF Plug-in may be used in any plug-in sweeper mainframe currently manufactured by Systron-Donner and in all sweeper mainframes manufactured earlier with the *Kruse Electronics* (a division of Systron-Donner) nameplate. Compatibility of the 5010 plug-in with these mainframes is delineated in Table 1-1.

Model 540 mainframes, unless equipped with Option M3 or M4, do not provide the outputs necessary to take advantage of the marker capability of the 5010. All Model 540B mainframes are equipped with marker outputs.

1-3.4 Leveling and Amplitude Control

Several methods of leveling (controlling the output amplitude of the plug-in to generate an essentially unvarying power level over the swept frequency range) and amplitude modulation are available. The output may be leveled by the feedback from an internal square-law detector (Option M2 only) or an external negative-output crystal detector, or leveled by the output of a microwave power meter (Options M7 and M7A). The 5010 may also be operated in an unleveled mode to obtain maximum peak power over narrow frequency ranges. The output may be modulated by a one kilohertz square wave generated within the 5010, or modulated by an externally-supplied input generated by or fed through the mainframe.

1-3.5 Frequency Modulation

In addition to the frequency-control signals from the mainframe, a phase-lock input signal may be coupled through the mainframe directly to an auxiliary tuning circuit in the RF oscillator module of the 5010. Deviations of up to plus or minus 350 megahertz from the nominal output frequency, at a bandwidth of approximately 5 kilohertz, are possible through the phase lock connection.

1-3.6 Optional Configurations

1-3.6.1 OPTION M2 INTERNAL LEVELING. Model 5010M2 includes an internal directional detector which is used to level the output of the plug-in when the front-panel **LEVELER** switch is set to **INT**. The output amplitude of the 5010M2 is identical within plus or minus 0.2 decibel over the full 500 to 1,000 megahertz range of the plug-in. Option M2 is available concurrently with Options M3/M3A, M6, M7/M7A, or M9.

NOTE

Unless specifically ordered without an internal leveler, all current-production 5010 RF plug-ins are equipped with Option M2.

1-3.6.2 OPTION M3 FAST AMPLITUDE MODULATION. This option adds a front-panel toggle switch marked **FAST AM/EXT DET** which allows an external attenuation-control voltage to be connected to the modulator input of the 5010's oscillator module through the front-panel **FAST AM/EXT DET** jack and an equalization network. Pulse risetimes and falltimes in *fast AM* mode are about 100 nanoseconds compared with the normal two to ten microsecond pulse response when external inputs are coupled through the leveler/amplitude modulation circuits. Option M3 may be ordered in a 5010M2, but is not available in RF Plug-ins which are equipped with Option M7 or M7A.

1-3.6.3 OPTION M3A FAST AMPLITUDE MODULATION. Model 5010M3A accepts an attenuation-control voltage through the mainframe in which it is installed. The specifications and signal requirements are identical to those of the 5010M3; Option M3A is not available concurrently with Option M7 or M7A, but is compatible with Option M2.

1-3.6.4 OPTION M6 CONSTANT-SENSITIVITY PHASE LOCK. This option modifies the 5010 to accept external phase-lock inputs into the main frequency tuning circuits rather than into the auxiliary tuning circuit of the oscillator module. The output of the 5010M6 is deviated at a constant factor of five megahertz per volt over the full frequency range of the 5010. Option M6 is available concurrent with Options M2, M3/M3A, M7/M7A, or M9.

1-3.6.5 OPTION M7 POWER METER LEVELING. Model 5010 RF plug-ins equipped with Option M7 are characterized by an additional front-panel toggle switch marked **POWER METER/NORMAL** and an additional circuit board mounted within the plug-in. The optional circuitry allows the output amplitude of the plug-in to be controlled by the analog output of any RF power meter which is of negative polarity and has a full-scale amplitude of one volt. The "recorder" output of Hewlett-Packard 431-series and similar power meters supplies the necessary levels for the 5010M7. Option M7 is compatible with Option M2, but is not available in 5010's with Option M3 or M3A.

1-3.6.6 OPTION M7A POWER METER LEVELING. Option M7A allows the 5010 to accept a positive-polarity power meter output as an amplitude-control (leveling) input. The zero to plus one volt "recorder" output of Hewlett-Packard 432, 435, and 436-series RF power meters is typical of acceptable inputs for the 5010M7A. Option M7A is compatible with Option M2, but is not available in 5010's with Option M3 or M3A.

1-3.6.7 OPTION M9 POWER CALIBRATION. The RF LEVEL control of a unit equipped with this option is calibrated in dBm (decibels referenced to one milliwatt). The dial of a standard 5010 is calibrated from zero to twenty milliwatts; Option M9 dials are calibrated from zero to plus thirteen dBm (a level of zero dBm is equivalent to one milliwatt into a 50 ohm load; plus thirteen dBm is equivalent to twenty milliwatts into 50 ohms). Power levels below zero dBm are uncalibrated.

1-4. ACCESSORIES

1-4.1 Model 9001 Storage Cabinet

The storage cabinet holds four 5000-series RF plug-ins with their dial scales, and bolts on to the side of a 5000 or 5000A mainframe to form a unit in 5¼ inches of rack space. The storage cabinet keeps the plug-ins available, and prevents loss of dial scales or damage to plug-ins.

1-4.2 Model 9202 Plug-in Extender

This unit fits between the sweeper mainframe and the 5010 RF plug-in to allow access to internal circuitry for trouble isolation and repair.

1-4.3 Model 9203 Plug-in Inverter

Used in conjunction with the 9202 extender, this maintenance accessory allows physical inversion of the 5010 for easier testing or trouble isolation of the oscillator driver circuit board.

1-4.4 Model 579-1 Dial Drum

When the 5010 is used with a Model 579 Adapter in a Model 540 or 540B mainframe, the plastic dial scale supplied with the RF plug-in must be replaced by a properly calibrated dial drum installed in the mainframe. The 579-1 has four separate dial scales on its drum covering the 10 to 110, 100 to 500, 500 to 1,000 (for Model 5010), and 1,000 to 2,000 megahertz frequency bands.

Table 1-1. Performance Specifications

ITEM	PARAMETER	SPECIFICATION
1	**Mainframe Compatibility**	
1.1	Model 5000*	All
1.2	Model 5000A	All
1.3	Model 540*	All, using Model 579 Adapter
1.4	Model 540B	All, using Model 579 Adapter
2	**Frequency Range**	
2.1	Rated	500 to 1,000 MHz
2.2	Usable	470 to 1,030 MHz
3	**Frequency Accuracy**	⩽ ±5.0 MHz @ 25° ambient and full power output

**Mainframes not in current production*

Table 1-1. Performance Specifications (Continued)

ITEM	PARAMETER	SPECIFICATION
4	**Frequency Stability**	Percent of output frequency, CW mode
4.1	Δ Temperature	⩽ ±0.05%/°C
4.2	Load VSWR from 1:1 to 3:1, any phase	⩽ ±1.0%
4.3	Δ RF Power, min to max	⩽ ±0.2%
4.4	Δ Line Voltage of ±10%	⩽ ±0.001% (worst-case combination of mainframe and Model 5010 specifications)
5	**RF Power Output**	Into 50 Ω load @ 25°C ambient
5.1	Unleveled	⩾ 25 mW (+14 dBm)
5.2	Leveled	⩾ 20 mW (+13 dBm)
6	**Power Control Range**	
6.1	Unleveled	⩾ 40 dB
6.2	Leveled	⩾ 6 dB
7	**Source VSWR**	⩽ 1.6:1 at any output amplitude
8	**Power Variation (Flatness)**	Over rated 500 to 1,000 MHz band
8.1	Unleveled	⩽ ±2 dB
8.2	Internally Leveled (Option M2)	⩽ ±0.2 dB
8.3	Externally Leveled	⩽ ±0.05 dB (excluding variations in external leveling apparatus)
9	**Spurious Signals**	Amplitude below full rated output, ⩾ 1 MHz from output frequency
9.1	Harmonically-related	⩾ 20 dB
9.2	Non-Harmonic	⩾ 60 dB
10	**Residual FM Deviation, CW Mode**	⩽ 2 kHz peak, 1 Hz to 30 kHz bandwidth
11	**Residual AM Index**	@ Full power output, 100 kHz bandwidth
11.1	Unleveled	⩾ −46 dB
11.2	Leveled	⩾ −40 dB
12	**Vernier Range**	10 MHz maximum
13	**ΔF Range**	±28 MHz maximum

Table 1-1. Performance Specifications (Continued)

ITEM	PARAMETER	SPECIFICATION
14	**External Phase Lock**	
14.1	Model 5010 or 5010M2	Normally-supplied configuration
14.1.1	Sensitivity at 500 MHz	20 MHz/V
14.1.2	Sensitivity at 1,000 MHz	1.5 MHz/V
14.1.3	Maximum Deviation	±350 MHz
14.1.4	3 dB Bandwidth	⩾ 5 kHz
14.1.5	Resistance	6 to 10 kΩ
14.1.6	Shunt Capacitance	1000 pF ±30%
14.1.7	Maximum Current	2 mA
14.1.8	Maximum Voltage	±40 V
14.2	Model 5010M6	With constant-sensitivity phase-lock option
14.2.1	Sensitivity	5 MHz/V
14.2.2	3 dB Bandwidth	1 kHz
14.2.3	Impedance	100 kΩ
14.2.4	Maximum Voltage	±100 V
15	**External Leveling**	
15.1	Model 5010 or 5010M2	Normally-supplied configuration
15.1.1	Sensitivity	–10 mV/mW
15.1.2	Impedance	5 kΩ
15.2	Model 5010M7	With negative power meter leveling option
15.2.1	Sensitivity	–1 V/mW @ 1 mW full scale
15.2.2	Maximum Input	–10 V
15.2.3	Impedance	5 kΩ nominal
15.3	Model 5010M7A	With positive power meter leveling option
15.3.1	Sensitivity	+1 V/mW @ 1 mW full scale
15.3.2	Maximum Input	+10 V
15.3.3	Impedance	⩾ 10 kΩ
16	Markers	
16.1	Minimum Marker Amplitude	⩽ 0.2 dB in leveled output mode
16.2	Maximum Marker Amplitude	⩾ 2 dB in leveled output mode
16.3	Marker Polarity	Reduces RF output amplitude
17	**Internal Amplitude Modulation**	
17.1	Waveform	Square wave
17.2	Frequency	1000 Hz
17.3	Stability	⩽ ±1 Hz
17.4	Adjustment Range	⩾ ±50 Hz
17.5	Symmetry	⩽ 5%
17.6	Risetime	⩽ 10 μs at maximum leveled output
17.7	Falltime	⩽ 10 μs at maximum leveled output
17.8	On/Off Ratio	⩾ 40 dB

Table 1-1. Performance Specifications (Continued)

ITEM	PARAMETER	SPECIFICATION
18	**External Amplitude Modulation**	Through mainframe connector
18.1	Model 5010 or 5010M2	Normally-supplied configuration
18.1.1	Sensitivity	+100 mV/mW in leveled mode
18.1.2	Maximum Input	+10 V peak
18.1.3	Impedance	⩾ 10 kΩ
18.1.4	3 dB Bandwidth	30 kHz nominal
18.2	Model 5010M3	With fast AM option
18.2.1	Sensitivity	2 dB/mA nominal
18.2.2	Maximum Current	–20 mAdc
18.2.3	Maximum Voltage Range	+600 mV to –6 Vdc
18.2.4	Risetime	⩽ 100 ns
18.2.5	Falltime	⩽ 100 ns
18.3	Model 5010M3A	With fast AM option
18.3.1	Sensitivity	2 dB/mA nominal
18.3.2	Maximum Current	–20 mAdc
18.3.3	Maximum Voltage Range	+600 mV to –6 Vdc
18.3.4	Risetime	⩽ 100 ns
18.3.5	Falltime	⩽ 100 ns
19	**Environment**	
19.1	Operating Temperature	0 to +55°C (+32 to +131°F) ambient
19.2	Storage Temperature	–55 to +85°C (–67 to +185°F)
19.3	Altitude	0 to 10,000 feet (3,05 kilometers)
20	**Dimensions**	
20.1	Height	2.40 inches (6,1 centimeters)
20.2	Width	3.87 inches (9,83 centimeters)
20.3	Depth	9.625 inches (24,5 centimeters)
21	**Weight**	≈ 2 pounds (907 grams)

SECTION II

INSTALLATION

2-1. UNPACKING AND INSPECTION

The RF plug-in is shipped in a specially-constructed container to provide maximum protection during transit. Use care when unpacking to prevent damage to the equipment, such as the front panel finish, switches, connectors, etc.

2-1.1 Removing Contents

To remove the plug-in from the shipping container, cut and fold back the outer carton top flaps, remove the top protective cushion, lift the plug-in clear from shipping container, and remove it from the dust protection bag.

2-1.2 Visual Inspection

The plug-in was carefully tested and inspected prior to shipment. Carefully inspect it for damage incurred during shipment. If the plug-in is damaged in any way, notify the freight carrier immediately. Do not discard any packing materials, as the freight carrier's agent will wish to examine them.

2-1.3 Electrical Inspection

Conformance with operation and performance specifications may be verified by following the *performance check* procedures in Section IV of this manual.

2-2. PREPARATION FOR USE

2-2.1 Frequency Calibration Scales

Depending upon the type of sweeper mainframe with which the RF plug-in is to be used, a clear plastic dial scale (5000 or 5000A) or a metal dial drum (540/579 or 540B/579) is required. The clear plastic dial scale is normally shipped with the plug-in at no charge.

2-2.2 Installation in 5000 or 5000A Sweeper (Figure 2-1)

To install a plug-in in one of these units:

1. Remove the clear plastic dial scale from the bracket on the right side of the plug-in by loosening the two captive knurled knobs.

2. Insert the RF plug-in through the rectangular hole in the sweeper front panel.

3. Lock the plug-in in place by turning the small knob at the top of the plug-in clockwise.

4. Install the clear plastic dial plate in the large rectangular cutout at the top of the sweeper.

5. Simultaneously tighten both knurled screws by turning them clockwise until they are finger tight. Be sure the dial fits in the panel without binding.

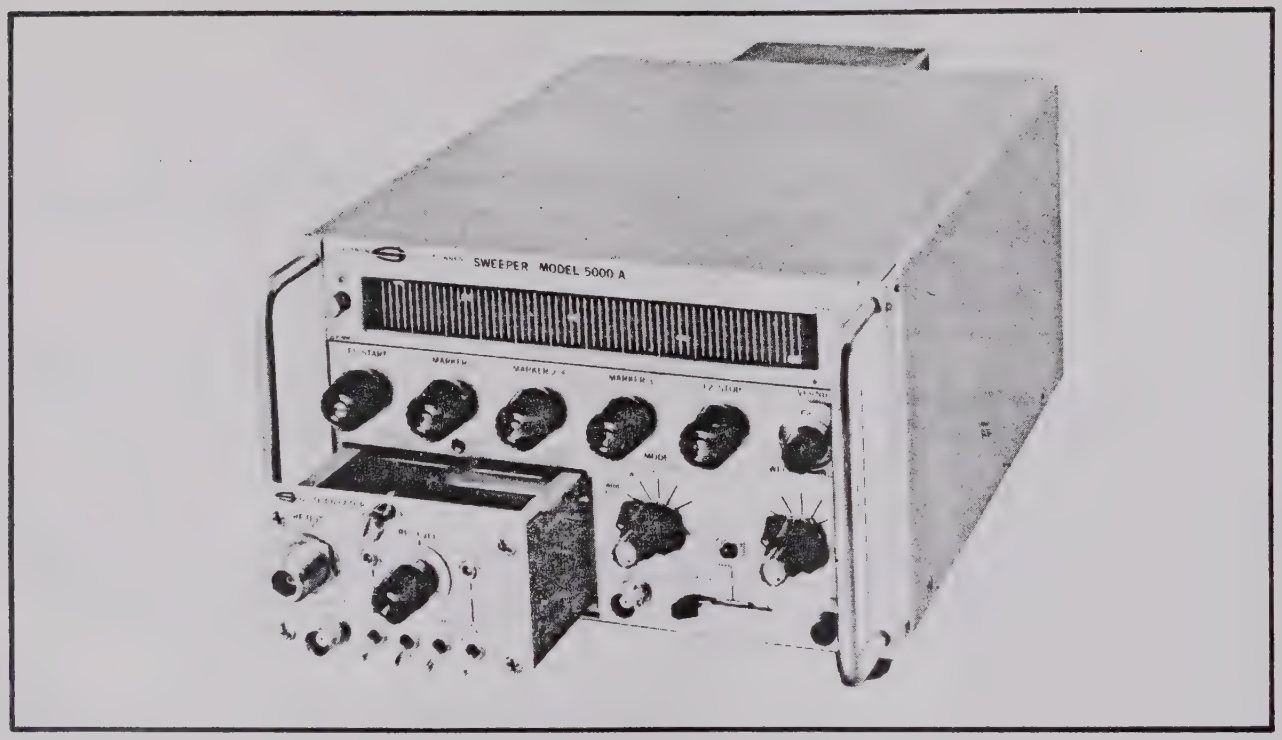


Figure 2-1. Installation in Model 5000A Mainframe

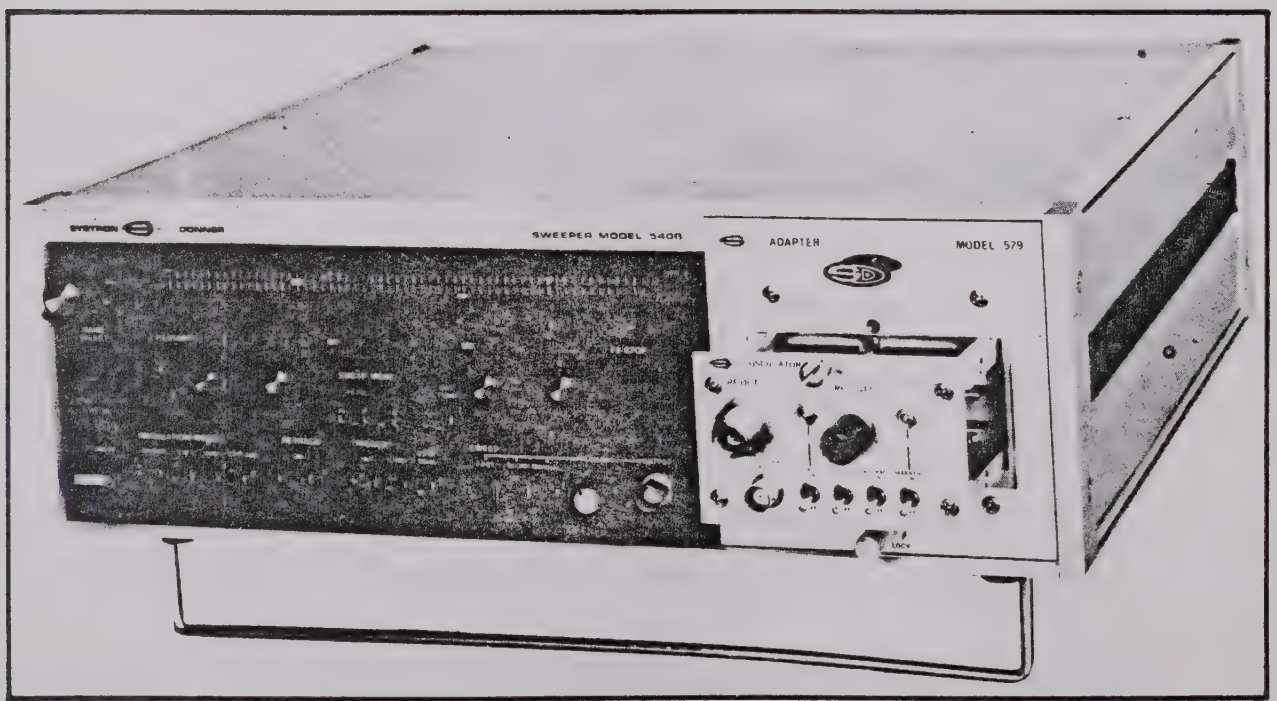


Figure 2-2. Installation in Model 540B with 579 Adapter

2-2.3 Installation in 540 or 540B Sweeper (Figure 2-2)

A single 5000-series RF plug-in may be installed in a Model 540 or 540B sweeper if it has been fitted with a Model 579 adapter:

1. Insert the RF plug-in into the rectangular hole in the center of the 579 adapter.
2. Lock the plug-in in place by turning the small knob at the top of the plug-in clockwise.
3. Set the **1 KHZ** switch of the RF plug-in to **OFF**.
4. Set the **RETRACE** switch of the RF plug-in to **ON**.
5. Connect a BNC cable between the **MARKER INPUT** connector on the rear panel of the 579 adapter and the **AMPLITUDE MARKER OUTPUT** connector on the rear panel of the 540B, 540M3, or 540M4 mainframe.
6. If necessary, install a new dial drum in the mainframe following steps 7 through *12*.
7. Remove the top cover of the mainframe; it is held in place with two screws.
8. Face the instrument, holding the dial scale drum with its smooth, rounded end knob to the right.
9. Push the smooth knob into its mating receptacle near the plug-in compartment shield. The spring will give way, allowing you to lower the left side of the drum.
10. Snap the drum into place and align the locating key with the mating groove in the left side of the drum assembly.
11. Rotate the **BAND SELECT** knob to ensure smooth operation of the drum assembly.
12. Set the **BAND SELECT** knob so that the dial scale matching the range of the RF plug-in is displayed.
13. Replace the top cover using the shorter screw on the right side.

2-3. REPACKAGING FOR SHIPMENT

If the plug-in is to be packaged for re-shipment, use the original shipping container and packaging material. If the original packaging has been discarded or is not in condition for re-use, perform the following packaging procedure. The plug-in may be shipped while it is housed within a mainframe:

1. Wrap the instrument in a heavy paper wrapping or plastic protective covering.
2. Place protective cushion in the bottom of shipping carton and place the instrument on the cushion.
3. Surround the remaining sides and top with additional protective cushions. Place front and rear cushions to provide support of the instrument without resting on the controls or connectors.

2-4. SHIPPING METHOD

This instrument should be shipped only by truck freight, air freight, or parcel delivery service. If it is shipped by parcel post, damage is likely to occur. Systron-Donner is not responsible for units damaged in shipment to the factory for repair, whether such units are in warranty or not.

2-5. INSURANCE

For your own protection, insure the unit for full value whenever it is shipped.

2-6. RETURNS FOR REPAIR

Be sure to fully identify any instrument that is returned to Systron-Donner for repair of any kind, in-warranty or not. The paperwork with the unit must show the instrument serial number, a description of the problem or malfunction to be corrected, and the exact address to which the instrument should be returned when repair is completed. Please also include the *name* and *telephone number* of the cognizant party in your organization; this may speed the identification and repair of malfunctions.

SECTION III

OPERATING INSTRUCTIONS

3-1. SCOPE

This section contains descriptions of all operating controls and indicators, an initial operating procedure, and a summary of precautions for proper usage of the 5010 RF plug-in. Specific operating instructions for the sweeper mainframe are contained in the manual supplied with the sweeper.

3-2. FRONT-PANEL CONTROLS AND CONNECTORS

The front-panel controls and connectors are illustrated in Figure 3-1, and are listed and described in Table 3-1.

3-3. INITIAL OPERATING PROCEDURES

Figure 3-2 contains condensed initial operating procedures for the 5010 and 5000A mainframe. These procedures are applicable to any swept signal measurement situation over the operating range of the plug-in, and generally apply to any mainframe in which the 5010 may be used.

3-4. HINTS AND PRECAUTIONS

3-4.1 Changing Plug-ins

It is imperative that the mainframe power be turned off before removing or inserting the 5010 RF plug-in. Serious damage to the 5010 or mainframe could result if this caution is ignored.

3-4.2 Internal Square Wave Generator

The internal one kilohertz generator drives the modulator with a square wave, reducing the RF output of the 5010 to zero on positive peaks. Most VSWR amplifiers and ratiometers will respond to the demodulated one kilohertz signal. If one of these units is being used, the **1 KHZ ADJ** control should be tuned for maximum response of the meter in use before measurements are made. Tuning the plug-in modulating frequency to that of the VSWR amplifier will considerably increase the measurement accuracy and signal-to-noise ratio.

When the 5010 is used in a 540-series mainframe with 579 adapter, the 5010's **1 KHZ** switch should be set to **OFF**; 540-series mainframes have internal one kilohertz generators. The **MODULATION MODE 1 KHZ** switch of the 540 or 540B should be used to control the one kilohertz modulating signal. The frequency of the square wave may be adjusted with a mainframe rear-panel adjustment.

3-4.3 External Amplitude Modulation

Each mainframe in which the 5010 may be used has a rear-panel connector through which external amplitude modulation signals may be coupled to the leveler/amplitude modulation circuits, where they are summed with all other amplitude modulation signals (internal one kilohertz, **RF LEVEL** control setting, retrace blanking, and markers).

This external input is dc-coupled, at a sensitivity of 100 millivolts per milliwatt of RF output. A negative-polarity input will decrease the output amplitude of the 5010; positive inputs will increase the amplitude. An input level of minus seven volts is sufficient to overcome the effects of all other amplitude-control signals, functioning as a remote "RF off" signal.

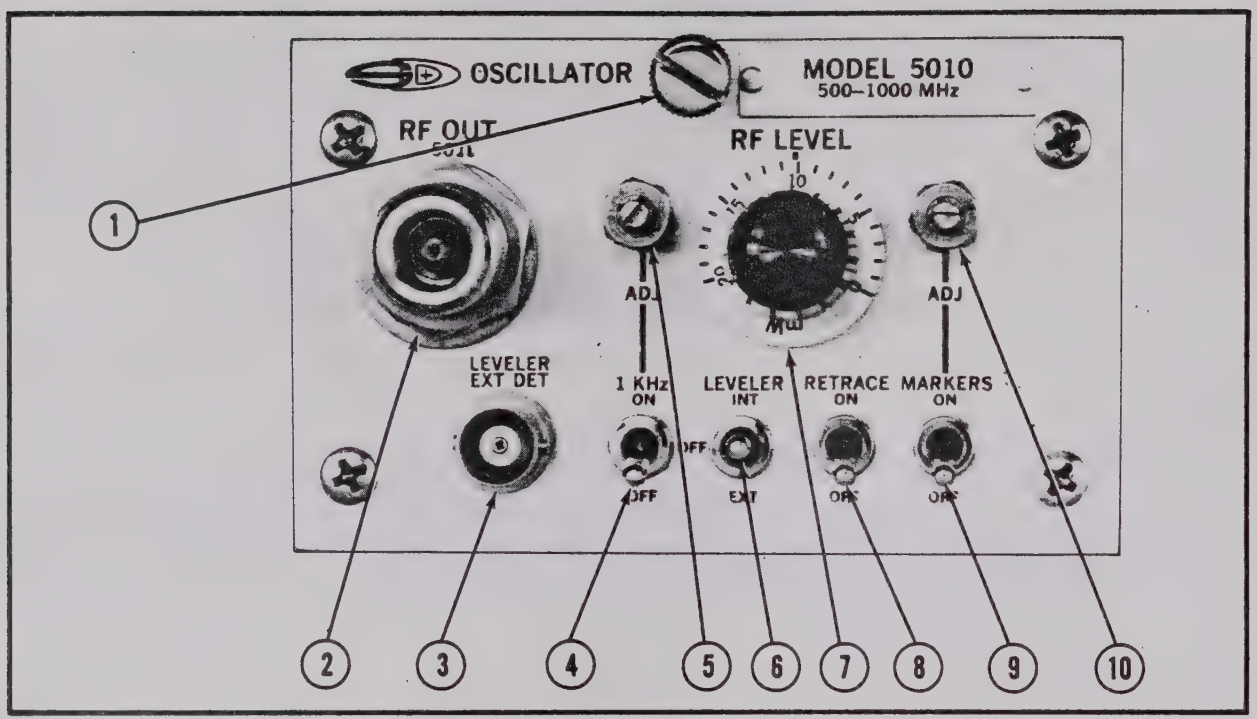


Figure 3-1. Model 5010 Front-Panel Controls and Connectors

Table 3-1. Model 5010 RF Plug-in Controls and Connectors

INDEX NO. (FIG. 3-1)	FRONT PANEL NAME AND DESCRIPTION	FUNCTION
1	Locking Screw	Used to lock plug-in in place in mainframe. *NOTE: This knob must be tightened to ensure low noise and proper seating of the interface connector.*
2	**RF OUT 50Ω** connector	The RF output of the plug-in is coupled through the precision Type N connector. The output impedance at this port is 50 Ω.
3	**LEVELER EXT DET** connector	Accepts video output of external directional detector for precision power leveling at the load. Sensitivity is approximately 10 mV/mW of output power. Input impedance is 5 kΩ, negative polarity. For Model 5010M7, a zero to –1 V power meter "recorder" output signal may be used instead of the output of a crystal detector.
4	**1 KHZ** switch	When set to **ON**, 100% amplitude-modulates the RF output of the 5010 with a 1 kHz square wave.

Table 3-1. Model 5010 RF Plug-in Controls and Connectors (Continued)

INDEX NO. (FIG. 3-1)	FRONT PANEL NAME AND DESCRIPTION	FUNCTION
5	**1 KHZ ADJ** control	Controls the frequency of the internal 1 kHz square wave generator from ≈ 950 to 1050 Hz.
6	**LEVELER** switch	Selects method of leveling RF output amplitude of 5010:
	INT	The internal directional detector (Model 5010M2 only) is used to maintain the amplitude at the **RF OUT 50Ω** connector constant over the full 500 to 1,000 MHz range. The **RF LEVEL** control markings are calibrated in internal leveling mode.
	OFF	The RF output is unleveled but controllable: the **RF LEVEL** control is used to adjust the output amplitude of the 5010. Maximum peak power output is available in this position. This position is used for external power meter leveling with Model 5010M7A.
	EXT	The 5010 is externally leveled using an appropriate directional detector. In this position, an external negative voltage at the **LEVELER EXT DET** connector is used to control the RF output. Model 5010M7 may be leveled with the 0 to −1 V output of a power meter through this port.
7	**RF LEVEL** control	Setting determines the RF output amplitude of the 5010. This control typically has a range of over 40 dB in unleveled and at least 6 dB in leveled mode. The 0 to 20 mW (0 to +13 dBm for 5010M9) dial calibration markings are accurate when the internal leveler is used. The dial is not calibrated in unleveled mode.
8	**RETRACE** switch	When set to **ON**, RF output is left on during the time the sweep circuits are retracing. When the switch is set to **OFF**, the internal modulator is automatically set to maximum attenuation during sweep retrace.
9	**MARKERS** switch	When set to **ON**, turns on RF dip markers as set by mainframe controls. The switch is set to **OFF** when the 5010 is used in any sweeper mainframe other than the 5000 or 5000A.

Table 3-1. Model 5010 RF Plug-in Controls and Connectors (Continued)

INDEX NO. (FIG. 3-1)	FRONT PANEL NAME AND DESCRIPTION	FUNCTION
10	**MARKERS ADJ** control	Setting determines amount of RF signal attenuation at marker points and thus the size of the markers. Range of this control when the 5010 is operating in leveled mode is ≈ 0.2 to 2.0 dB.
Not Shown	**FAST AM** switch	Present in Models 5010M3 and 5010M3A; this switch is set to **EXT DET** to use the leveling, amplitude-control, and modulation functions of the mainframe and 5010. When this switch is set to **FAST AM**, an external amplitude-control signal may be connected to the PIN-diode modulator in the oscillator module through the **EXT DET/FAST AM** connector (Option M3) or through the *external A.M.* jack of the mainframe (Option M3A).
Not Shown	**POWER METER** switch	Present in Models 5010M7 and 5010M7A; this switch is set to **NORMAL** in order to level the RF output with an external directional detector. The 0 to –1 V (Option M7) or 0 to +1 V (Option M7A) output of an RF power meter is used for leveling when the switch is set to **POWER METER**.

3-4.4 Leveling

Leveling is the process which overcomes the natural tendency of radio frequency sources to generate different power levels at different frequencies due to resonances, losses, and other frequency-sensitive factors. The desired end result is identical output power over the full 500 to 1,000 megahertz range of the 5010. When internal leveling is used, the amplitude at the **RF OUT 50Ω** connector is essentially identical for all output frequencies.

Where long output cables are used, leveling should be accomplished as closely as possible to the point of measurement.

The front-panel **LEVELER EXT DET** connector accepts the input from a directional detector at a sensitivity of minus ten millivolts per milliwatt. The actual power level at the output connector of the directional detector is indicated by the dial markings on the **RF LEVEL** control.

An effective directional detector can be assembled from a 16 decibel directional coupler which is flat over the 500 to 1,000 megahertz band and a crystal detector with matching square-law load.

If the 5010 is equipped with power meter leveling Option M7 or M7A, the **POWER METER/NORMAL** switch must be set to **NORMAL** when the internal leveler (Option M2) or an external crystal detector is used as the leveling element. Response time of the leveling circuitry is slowed considerably in a power meter leveling mode.

NOTE

If the **LEVELER** switch is set to **EXT**, and an external leveler is not connected, it will not be possible to control the output amplitude with the **RF LEVEL** control. The RF output will either be completely off or at maximum amplitude. This is also true if the **LEVELER** switch is set to **INT** in a 5010 which has been ordered without Option M2 Internal Leveling.

3-4.5 Fast AM

Model 5010M3 and 5010M3A RF plug-ins will accept an external amplitude-control input of negative polarity to the PIN diode modulator within the oscillator module. The attenuation factor is approximately linear at one-half decibel per milliampere to a maximum of 20 milliamperes for the rated maximum attenuation of 40 decibels. The maximum allowable amplitude for this input is six volts negative or 600 millivolts positive.

The control-current input port for Model 5010M3 is the front-panel **FAST AM/EXT DET** jack; the input port for Model 5010M3A is the rear-panel *external A.M.* jack of the mainframe or adapter.

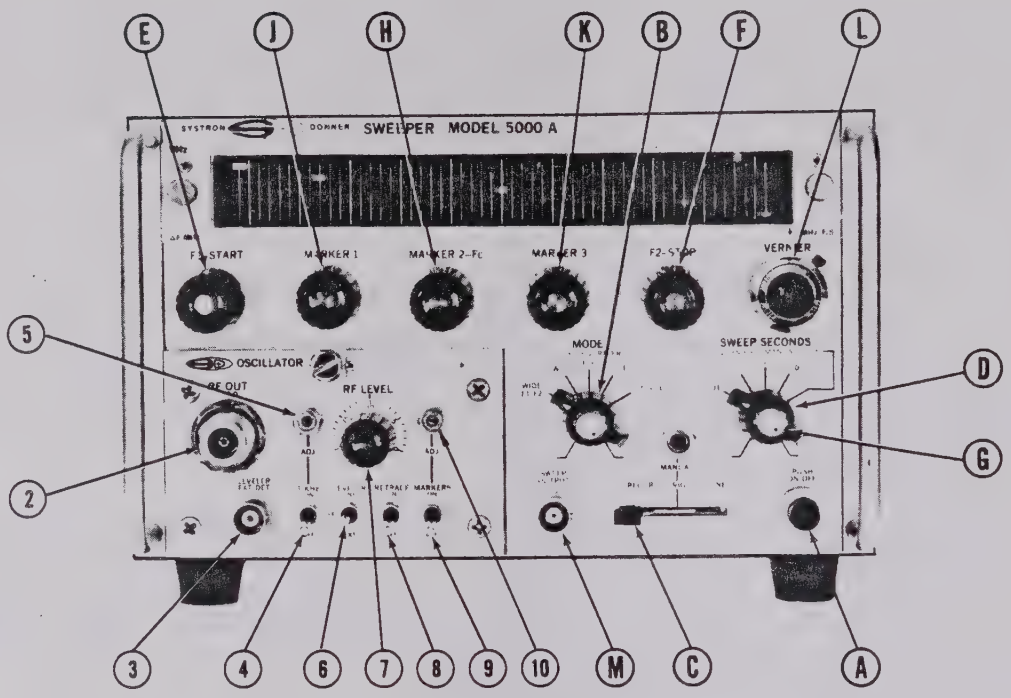
To use the fast AM capability, set the 5010's **FAST AM/EXT DET** switch to **FAST AM** and the **LEVELER** switch to **OFF**. The leveling, one kilohertz, retrace blanking, and marker functions of the 5010M3/5010M3A will not be available in *fast AM* mode.

3-4.6 Power Meter Leveling

Model 5010M7 RF plug-ins will accept an external leveling input from a negative-output crystal detector as described in Paragraph 3-4.4 above, or may be leveled with the analog "recorder" output of any power meter which has a negative one-volt level corresponding to full scale. Power meters such as Hewlett-Packard 431B, 431C, and many others provide this output. The **LEVELER** switch must be set to **EXT** and the **POWER METER/NORMAL** switch to **POWER METER**; the input is connected to the **LEVELER EXT DET** connector.

Model 5010M7A is similar, but accepts the positive one-volt output of a power meter such as Hewlett-Packard 432, 435, 436, and units from other manufacturers. To use positive power meter leveling, the front-panel **POWER METER/NORMAL** switch must be set to **NORMAL**, the **LEVELER** switch to **OFF**, and the power meter output connected to the rear-panel *external A.M.* jack of the mainframe.

Both modes of power meter leveling are suitable for use only at the slower sweep speeds. The thermoelectric detection elements used in most power meters have relatively slow response to amplitude changes and will not properly level the 5010 when the mainframe is operating in a fast sweep mode. The response time of the 5010 leveling circuitry is also reduced in power meter leveling mode, and will not accept fast amplitude changes.



A. PRELIMINARY CONTROL SETTINGS IN 5000A

Control	Setting
RF LEVEL (7)	Maximum CCW
PUSH ON-OFF (A)	Depressed to turn mainframe power on
RF OUT 50 Ω (2)	Connect suitable RF output cable to circuit or device to be sweep tested
1 KHZ (4)	OFF
MODE (B)	WIDE F1–F2
RETRACE (8)	OFF
MARKERS (9)	OFF
TRIGGER (C)	RECUR
SWEEP SECONDS (D)	.1
SWEEP SECONDS VERNIER (G)	x1

B. TYPICAL TEST METHOD IN 5000A

Control	Setting
F1–START (E)	Adjust so *GOLD* dial indicator is at lowest frequency of interest

Figure 3-2. Initial Operating Procedures (Sheet 1 of 3)

F2–STOP (F)	Adjust so *ORANGE* dial indicator is at highest frequency of interest
LEVELER (6)	INT (OFF if 5010 does not have Option M2)
RF LEVEL (7)	Slowly increase the RF output of the plug-in while observing detected response of test item on display unit (oscilloscope or chart recorder).

Continue to increase the RF amplitude until the desired power level is reached. If an external leveler is used, connect its input to **LEVELER EXT DET** (3) and set the **LEVELER** switch (6) to **EXT**. Increase power until the output becomes unleveled as indicated on the display unit trace. Reduce setting of **RF LEVEL** control (7) as required.

If the shape of the swept response changes as a function of **SWEEP SECONDS VERNIER** (G) setting, reduce sweep speed until the distortion is no longer evident. This effect may be noticed when sweeping high-Q circuits, when the crystal detector output capacitor is of high value, or when logarithmic converters are used at the display unit input. In general, use the lowest sweep speed which allows comfortable viewing of the display unit trace with minimal distortion.

To use direct reading frequency markers, set **MARKERS** switch (9) to **ON**.

Adjust **MARKER 2** (H) until the pip on the trace is over an area of interest in the swept response curve. The frequency of the discontinuity, anomaly, or other event is shown by the *RED* dial indicator. Adjust **MARKER 1** (J) and **MARKER 3** (K) to calibrate the swept response curve at points on either side of the frequency of interest. In many cases, it will be desirable to examine parts of the trace using narrow sweeps without disturbing the F1—F2 settings:

Control	Setting
MARKER 2–Fc (H)	Adjust so marker 2 is centered in the narrow band area of interest
MODE (B)	Fc ± ΔF x 1
MARKER 1 (J)	Set marker 1 so *GREEN* indicator shows lower calibration frequency on lower part of frequency scale
MARKER 3 (K)	Set marker 3 so *BLUE* indicator shows upper calibration frequency on lower part of frequency scale
Fc ± ΔF VERNIER (M)	Set to **CALIB**. When ΔF sweep width is reduced by rotating control CCW, Markers 1 and 3 become uncalibrated.

Figure 3-2. Initial Operating Procedures (Sheet 2 of 3)

C. OTHER CONTROLS

1. **TRIGGER** (C) : Trigger modes other than recurrent have specific uses. In line trigger mode, the effects of power ground loops or power line-frequency noise in the displayed swept response curve can be minimized by synchronizing the sweep with these components. Manual mode is used for single sweeps or sweeps triggered on command when chart recorders or other plotting devices are used.

2. **RETRACE** (8) : If a fast-rising pulse caused by turning off the RF output of the plug-in during retrace is causing distortion at the ends of the display unit trace, depress this pushbutton to leave RF on during retrace. This is also recommended if power meters are used in the system.

3. **1 KHZ** (4) : Use the 1 kHz square wave to amplitude-modulate the RF output for use with VSWR detectors or ratiometers.

4. **VERNIER** (L) : For fine frequency adjustments in CW and narrow Fc ± ΔF sweeps; read frequency up to 10 MHz which must be added to frequency indicated by the *RED* indicator on upper part of dial scale. VERNIER must be set to 0.0 (full ccw) to ensure accuracy of frequency readings.

Figure 3-2. Initial Operating Procedures (Sheet 3 of 3)

3-4.7 Retrace

When the front-panel **RETRACE** switch is set to **OFF**, the internal modulator of the 5010 is automatically driven to maximum attenuation during the time the sweep ramp from the mainframe is retracing. This eliminates a possibly confusing extra trace from the oscilloscope or display unit screen. However, under certain circumstances, the **RETRACE** switch should be set to **ON** where it is desired that the RF output of the 5010 remain on at all times, such as when average power is being measured, when certain chart recorders are being used, and when phase-locked systems are in use. The fast-rising pulses at both ends of sweep might cause measurement errors.

If an RF power meter is being used to measure output power of the plug-in at high sweep speeds, it will indicate average power over the swept band, provided the sweep retrace is not blanked. Setting the **RETRACE** switch to **OFF** will blank the RF output during sweep retrace and cause the power meter to indicate a lower power amplitude than is actually present. The fast-rising and falling voltages of the beginning and end of sweep retrace will also cause disturbances when logarithmic converters or crystal-detector type logarithmic power meters are used, causing abnormal power levels to be indicated at fast sweep speeds.

When the 5010 is used in a 540 or 540B mainframe with a 579 adapter, the plug-in's **RETRACE** switch should be left at **ON**, and the **RETRACE** switch on the mainframe or controller used to select the retrace mode.

3-4.8 Markers

Markers are generated in the 5010 plug-in by momentarily reducing the RF output power in response to marker signals from the mainframe (Model 540 mainframes must be equipped with Option M3 or M4).

The size of the markers is controlled by the front-panel **MARKERS ADJ** potentiometer; the minimum size is equivalent to a power reduction of about 0.2 decibel. Under certain circumstances, RF dip markers may not be usable; where there is a great deal of attenuation in the system under test, or when the 5010 is generating maximum unleveled power, the markers may not be visible on the detected waveform. In these cases, the other methods of marker generation (video bypass, intensity, sweep stop) described in the mainframe manual should be used. Very high "Q" circuits may cause oscillations (ringing) at marker points due to the fast rise and fall times of the marker pulses. In these cases, too, an alternate method of marker generation *not* involving output amplitude reduction should be employed.

3-4.9 Phase Lock Input

The phase lock input for the 5010 RF plug-in is physically located on the rear panel of the mainframe or adapter, but electrically connects directly to the oscillator module in the plug-in. Generally, the phase lock input is used to directly control the oscillator frequency to maintain a fixed output frequency or to generate FM. In the first case, the output of a discriminator is commonly used; in the second case, the ac-coupled output of a low-frequency oscillator is used.

Because the varactor tuning capacitors used in the oscillator module are not linear devices, the sensitivity of the phase lock input varies with the basic output frequency of the 5010 plug-in. Phase lock sensitivity at a basic output frequency of 500 megahertz is approximately 20 megahertz per volt; the sensitivity at 1,000 megahertz is approximately 1.5 megahertz per volt.

The maximum permissible input is 40 volts at 2 milliamperes. The maximum deviation from the basic output frequency is 350 megahertz. The phase-lock input is dc coupled, with a maximum tuning rate of 5 kilohertz.

If linear tuning of the phase-lock input is required, Model 5010M6 with the optional *constant sensitivity phase lock* connection should be used. The sensitivity is a constant five megahertz per volt over the 500 to 1,000 megahertz band at a maximum tuning rate of one kilohertz. Modification instructions for converting the 5010 to constant sensitivity phase-lock operation can be found in Section V of this manual.

The polarity of the standard or optional phase-lock input determines the direction of frequency deviation; positive inputs increase the output frequency and negative inputs decrease it.

To ensure low residual FM in the RF output, it is important that the phase-lock input be short-circuited when it is not in use. The **PHASE LOCK** jack on the 5000A mainframe or 579 adapter is self-shorting when the mating plug is removed. An unterminated lead connected to the **PHASE LOCK** jack will act as an antenna, coupling electromagnetic and electrostatic noise into the frequency-control circuits of the 5010.

SECTION IV

PERFORMANCE CHECKS AND CALIBRATION

4-1. GENERAL

This section contains procedures for testing the electrical performance of the 5010 RF Plug-in and calibrating the unit when necessary. Frequency calibration in the field is limited to very narrow parameters, and 5010's requiring extensive recalibration should be returned to the Microwave Division for service.

Calibration accuracy checks should be undertaken only by qualified personnel with sufficient experience and knowledge to ensure that proper test methods are employed. Use standard maintenance and metrology practices when working on the plug-in.

4-2. PERFORMANCE CHECKS

This paragraph contains the performance check procedures listed in Table 4-1. These performance checks verify that the instrument meets the applicable performance specifications in Table 1-1. Failure to meet the specified performance limits indicates the need for repair or recalibration in accordance with the procedures of Paragraph 4-3.

The following performance checks may be made at any time, and should be performed annually in the order indicated. If these checks reveal the need for repair or recalibration of the instrument, it should be returned to Systron-Donner or another qualified metrology laboratory so that the calibration procedures in Paragraph 4-3 may be accomplished. Frequency calibration and linearization can be accomplished only at a Systron-Donner metrology laboratory or at the Microwave Division.

4-2.1 Equipment Required

The test equipment required to check performance of the plug-in is listed in Table 4-2. All test equipment should bear evidence of recent calibration by a qualified metrology laboratory. Equipment equivalent to that listed in Table 4-2 may be used, but care should be taken to ensure that the rated accuracy of the equipment used is truly equivalent to that cited. In any case, the maximum rated inaccuracy of a piece of test equipment used to measure any parameter must not be greater than one-tenth the maximum inaccuracy which can be tolerated in the measurement.

4-2.2 Alternate Test Equipment

In many cases the recommended test equipment will not be available but alternate test equipment can be constructed from standard coaxial components and instruments.

4-2.2.1 **POWER METER.** The Systron-Donner Model 4020A is listed because it combines the features of an RF power meter and a logarithmic converter; in measurements requiring readout in logarithmic terms (decibel measurements), the 4020A will read directly in terms of the measurements. The output of the 4020A, when fed to a general-purpose linear oscilloscope, allows measurement in terms of 1.0 or 10.0 decibels per linear graticule division.

If such a power meter is not available, any high-quality power meter with a dynamic range of 50 decibels may be used for power measurements. Some acceptable instruments are Hewlett-Packard Model 432, 435, or 436, PRD 686, Boonton 42, etc. (all with appropriate temperature-compensated thermistor mounts rated to operate over the 500 to 1,000 megahertz band).

Table 4-1. Performance Checks

PARAGRAPH NUMBER	PROCEDURE	SPECIFICATION REFERENCE ITEM (TABLE 1-1)
4-2.4	Frequency Accuracy	2, 3
4-2.5	Power Output and Internal Leveling Flatness	5, 8
4-2.6	Power Output and External Leveling Flatness	5, 8
4-2.7	Unleveled Power Output and Flatness	5, 8
4-2.8	Residual Amplitude Modulation	11
4-2.9	Oscillator Pulling and Attenuation	4.3, 6
4-2.10	Residual Frequency Modulation	10
4-2.11	Spurious and Harmonic Content	9
4-2.12	Internal Amplitude Modulation	17

Table 4-2. Test Equipment Required for Performance Checks

ITEM	TYPE OF EQUIPMENT	CHARACTERISTICS	RECOMMENDED MODEL *
1	Sweeper Mainframe	5010-compatible	Systron-Donner 5000A
2	Frequency Counter	500 to 1000 MHz	Systron-Donner 6243A
3	Spectrum Analyzer	500 MHz to 3 GHz; 1 kHz/Div. resolution	Systron-Donner 4809A with 2311A and 4701A
4	Digital Voltmeter	Resolution 1 mV on 10V scale	Systron-Donner 7141A
5	Oscilloscope	High sensitivity with variable bandwidth, fast-rise	Tektronix 5403 mainframe, 5A22 and 5A48 amplifiers, 5B42 time base
6	Sweep Voltage Attenuator	20:1, 1 kΩ minimum input impedance	Construct if oscilloscope with fixed 50 mV/Div. external sweep is used.
7	RF Power Meter	500 to 1000 MHz	Systron-Donner 4020A
8	Directional Detector	500 to 1000 MHz; –10 mV/mW	Systron-Donner 1025
9	Crystal Detector	500 to 1000 MHz. Type N connector; 0.4 mV/μW	Systron-Donner 306
10	RF Attenuator	10 dB, 500 to 1000 MHz. Type N connectors.	Systron-Donner 441A-10
11	RF Cable	50 Ω; Type N connectors, 500 to 1000 MHz	Systron-Donner 36000-158
12	RF Cable, 24"	50 Ω; BNC to BNC	ITT Pomona 2249-C-24
13	RF Adapter	N male to BNC female	ITT Pomona 3288
14	RF Adapter	N male to N male	Systron-Donner 051-1
15	Feedthrough Termination	50 Ω	Tektronix 011-0049-01
16	RF Adapter	BNC Tee	UG-274A/U
17	Patch Cable, 24"	Dual Banana Plug to BNC	H.H. Smith 1584-24

**Equipment having equivalent characteristics may be used*

4-2.2.2 DIRECTIONAL DETECTOR. If the specified directional detector is not available, an appropriate high-directivity 500 to 1,000 megaherz coaxial coupler can be substituted. The coupling factor of the unit should be 16 decibels, and the coupled output must be fitted with a crystal detector rated for the same frequency range. The combined flatness error of the directional coupler and crystal detector should not exceed plus or minus one-half decibel over the 500 to 1,000 megahertz frequency range.

4-2.3 Initial Setup

4-2.3.1 DESCRIPTION. Various controls are preset to desired positions to facilitate subsequent measurements. Connect the equipment and set controls as described below. Do not apply power at this time. All mainframe controls and functions called out in this or subsequent procedures are based upon Model 5000A markings and capabilities. If a mainframe other than Model 5000A is used, make the appropriate corrections in control names and positions. The mainframe markings and functions are similar enough so that no difficulty should be experienced in the translation.

4-2.3.2 PROCEDURE.

1. Install the RF plug-in and dial scale in accordance with the instructions in Section II; be sure to turn the locking knob cw to secure the 5010 in the mainframe.
2. Set the mainframe **F1–START** control to its maximum ccw position.
3. Set the mainframe **F2–STOP** control to its maximum cw position.
4. Set the **MODE** switch to **CW**.
5. Set the 5010 **1 KHZ** switch to **OFF**.
6. Set the **LEVELER** switch to **INT**. If the 5010 is not equipped with Option M2 Internal Leveling, set the **LEVELER** switch to **OFF**.
7. Set the **RETRACE** switch to **OFF**.
8. Set the **MARKERS** switch to **OFF**.
9. Set the **RF LEVEL** control to its maximum ccw position.
10. Set the mainframe **VERNIER** control to **0.0** (maximum ccw).
11. Turn on the mainframe power switch, then allow the units to warm up for 5 to 10 minutes.

4-2.4 Frequency Accuracy

4-2.4.1 DESCRIPTION. The RF output frequency is measured to ensure that the indicated and actual output frequencies are coincident within the specified tolerance.

NOTE

In order to obtain meaningful results, the dial accuracy of the mainframe must have been checked, and calibrated if necessary, immediately before beginning this procedure.

4-2.4.2 PROCEDURE. Frequency accuracy should be checked at an ambient air temperature of +25°C (+77°F). When setting the frequency, take care to view the indicators straight on to eliminate parallax:

1. Using the 10-dB attenuator, connect the RF output of the plug-in to the input of the frequency counter as shown in Figure 4-1.

CAUTION

DAMAGE TO THE COUNTER MAY RESULT IF THE ATTENUATOR IS NOT USED.

2. Set the **RF LEVEL** control to **20 mW**.

3. Carefully set the **MARKER 2—Fc** control so that the *RED* indicator is aligned with the 500 MHz dial mark on the upper part of the scale.

4. The frequency counter must show 500 MHz ±5 MHz.

5. Repeat the test for as many dial marks as you wish to test (testing every 100 MHz is usually sufficient). The frequency tolerance must not exceed ±5 MHz of the indicated frequency at any point.

6. Connect the digital voltmeter to the mainframe **FREQ VOLT** jack.

7. Select the 10 Vdc range of the DVM.

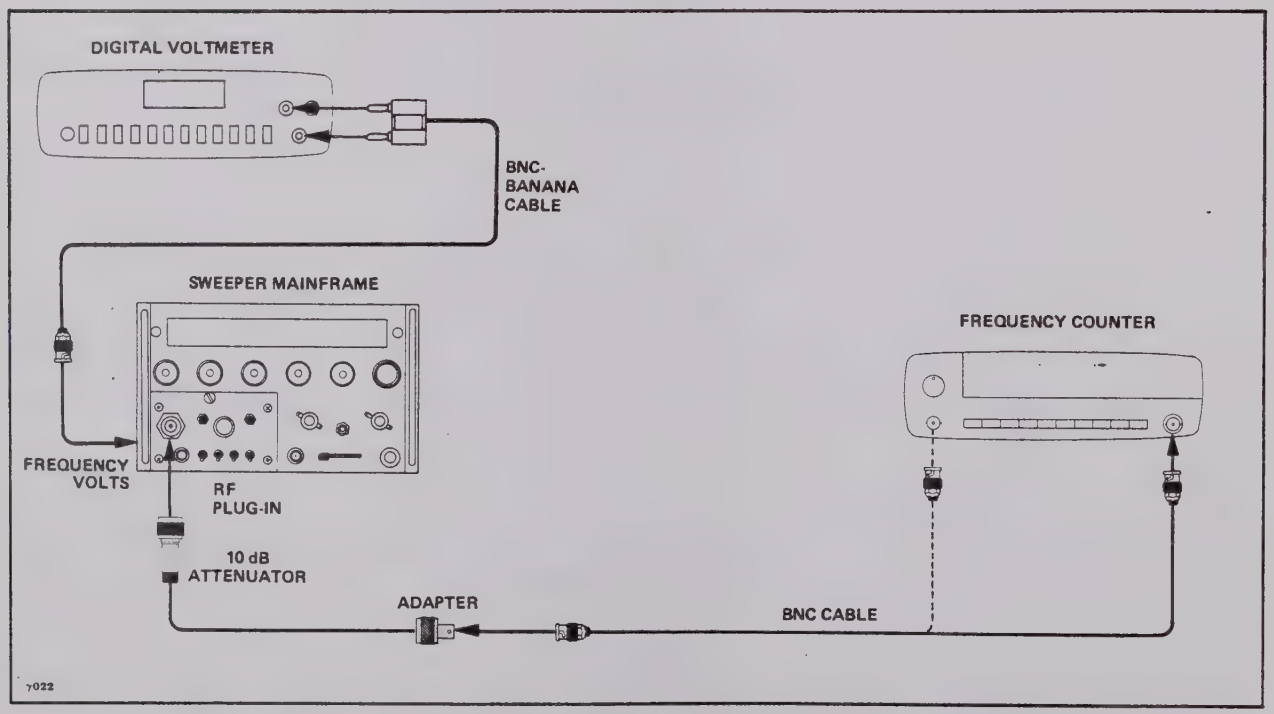


Figure 4-1. Test Setup for Frequency Accuracy Performance Checks

8. Adjust the **MARKER 2—Fc** control for a DVM reading of –0.100 ±0.005 Vdc.

9. Verify the frequency counter shows 470 ±5 MHz.

10. Adjust the **VERNIER** control to its maximum cw stop (**10.0**).

11. Verify the frequency increases by 10 ±1 MHz.

12. Rotate the **VERNIER** control to its maximum ccw stop (**0.0**) and lock it in place for the rest of this procedure.

13. Adjust the **MARKER 2—Fc** control for a DVM reading of –1.080 ±0.005 Vdc.

14. Verify the frequency is 526 ±5 MHz.

15. Adjust the **MARKER 2—Fc** control for a DVM reading of –2.060 ±0.005 Vdc.

16. Verify the frequency is 582 ±5 MHz.

17. Adjust the **MARKER 2—Fc** control for a DVM reading of –3.040 ±0.005 Vdc.

18. Verify the frequency is 638 ±5 MHz.

19. Adjust the **MARKER 2—Fc** control for a DVM reading of –4.020 ±0.005 Vdc.

20. Verify the frequency is 694 ±5 MHz.

21. Adjust the **MARKER 2—Fc** control for a DVM reading of –5.000 ±0.005 Vdc.

22. Verify the frequency is 750 ±5 MHz.

23. Adjust the **MARKER 2—Fc** control for a DVM reading of –5.980 ±0.005 Vdc.

24. Verify the frequency is 806 ±5 MHz.

25. Adjust the **MARKER 2—Fc** control for a DVM reading of –6.960 ±0.005 Vdc.

26. Verify the frequency is 862 ±5 MHz.

27. Adjust the **MARKER 2—Fc** control for a DVM reading of –7.940 ±0.005 Vdc.

28. Verify the frequency is 918 ±5 MHz.

29. Adjust the **MARKER 2—Fc** control for a DVM reading of –8.920 ±0.005 Vdc.

30. Verify the frequency is 974 ±5 MHz.

31. Adjust the **MARKER 2—Fc** control for a DVM reading of –9.900 ±0.005 Vdc.

32. Verify the frequency is 1,030 ±5 MHz.

4-2.5 Power Output and Internal Leveling Flatness

4-2.5.1 DESCRIPTION. The minimum output power over the 500 to 1,000 megahertz range of the 5010 is measured in leveled output mode using the internal directional detector. This procedure applies only to Model 5010 RF plug-ins equipped with Option M2. (All current production units include Option M2 unless specifically ordered without it.)

4-2.5.2 PROCEDURE.

1. Turn on the RF power meter and allow it to stabilize. The test setup at this time should be as shown in Figure 4-1.
2. Set the **RF LEVEL** control fully cw.
3. Set the 5000A **SWEEP SECONDS** switch to **MANUAL SCAN**.
4. Adjust the **MANUAL SCAN** control to maximum ccw rotation.
5. Set the **F1—START** control so the frequency counter reads 500 ±5 MHz.
6. Rotate the **MANUAL SCAN** control to maximum cw rotation.
7. Set the **F2—STOP** control so the counter reads 1,000 ±5 MHz.
8. Return the **MANUAL SCAN** control to maximum ccw and check the frequency reading; reset the **F1—START** control if necessary.
9. Remove the attenuator and counter input cable from the **RF OUT** connector of the 5010; connect the leveler and thermistor mount or power head of the power meter as shown in Figure 4-2.

IMPORTANT

The 10-dB attenuator must remain attached to the output connector of the leveler to reduce mismatch losses which might affect measurement accuracy and to avoid possible power meter damage.

10. Set the power meter to its 3 mW (+5 dBm) range (not necessary if Systron-Donner Model 4020A is used).

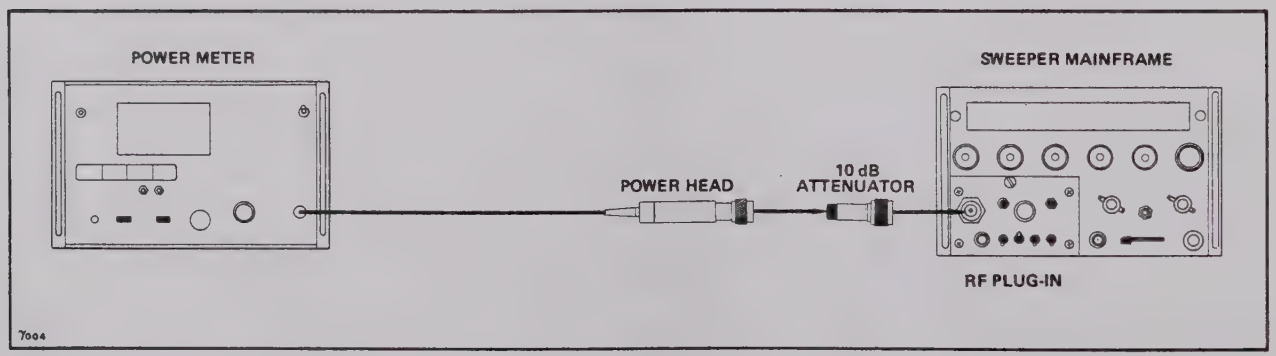


Figure 4-2. Test Setup for Power Output and Internal Leveling Flatness Performance Check

11. Slowly rotate the **MANUAL SCAN** control through its range; observe the power reading and locate the frequency at which the output amplitude is lowest.

12. Adjust the **RF LEVEL** control for a power level of exactly 20 mW (+13 dBm). Because a 10-dB attenuator was used, the power meter reading will be 2 mW (+3 dBm).

13. Slowly vary the **MANUAL SCAN** control over its full range again; check the power meter reading to ensure that the total power level increase over the band does not exceed 0.4 dB.

IMPORTANT

This procedure does not allow for variations in the 10-dB attenuator. The worst-case combination of 5010 and attenuator error is ⩽ ±0.75 dB.

14. Adjust the **RF LEVEL** control to the **5 mW** marking and note the power meter reading.

15. Rotate the **RF LEVEL** control to the **10 mW** marking; verify the power meter reading increases by 3.0 ±0.50 dB from the reading in Step *14*.

16. Rotate the **RF LEVEL** control to the **20 mW** marking and verify the amplitude increases by 6.0 ±0.75 dB from the reading in Step *14*.

4-2.6 Power Output and External Leveling Flatness

4-2.6.1 DESCRIPTION. The minimum output power over the 500 to 1,000 megahertz range of the 5010 is measured in leveled output mode using a matched directional detector. This procedure tests the 5010 and the leveling detector simultaneously.

IMPORTANT

The Systron-Donner Model 1025 is made specifically for leveling applications with the 5010 and other RF plug-ins in the 10 to 1,000 megahertz range. Most standard directional couplers are not sufficiently flat to level the output of the 5010 as closely as its own internal directional detector. If the 5010 under test has successfully completed the test procedure of Paragraph 4-2.5, and if it responds to the input from an external detector (even though the rated performance specifications may not be met), it should be deemed to have passed this procedure. ***If a Model 1025 leveler is used, all performance specifications delineated in this procedure must be met.***

4-2.6.2 PROCEDURE.

1. Turn on the RF power meter and allow it to stabilize. The test setup at this time should be as shown in Figure 4-1.

2. Set the **RF LEVEL** control fully cw.

3. Set the 5000A **SWEEP SECONDS** switch to **MANUAL SCAN**.

4. Adjust the **MANUAL SCAN** control to maximum ccw rotation.

5. Set the **F1—START** control so the frequency counter reads 500 ±5 MHz.

6. Rotate the **MANUAL SCAN** control to maximum cw rotation.

7. Set the **F2—STOP** control so the counter reads 1,000 ±5 MHz.

8. Return the **MANUAL SCAN** control to maximum ccw and check the frequency reading; reset the **F1—START** control if necessary.

9. Remove the attenuator and counter input cable from the **RF OUT** connector of the 5010; connect the leveler and thermistor mount or power head of the power meter as shown in Figure 4-3.

IMPORTANT

The 10-dB attenuator must remain attached to the output connector of the leveler to reduce mismatch losses which might affect measurement accuracy and to avoid possible power meter damage.

10. Set the **LEVELER** switch to **EXT**.

11. Set the power meter to its 3 mW (+5 dBm) range (not necessary if Systron-Donner Model 4020A is used).

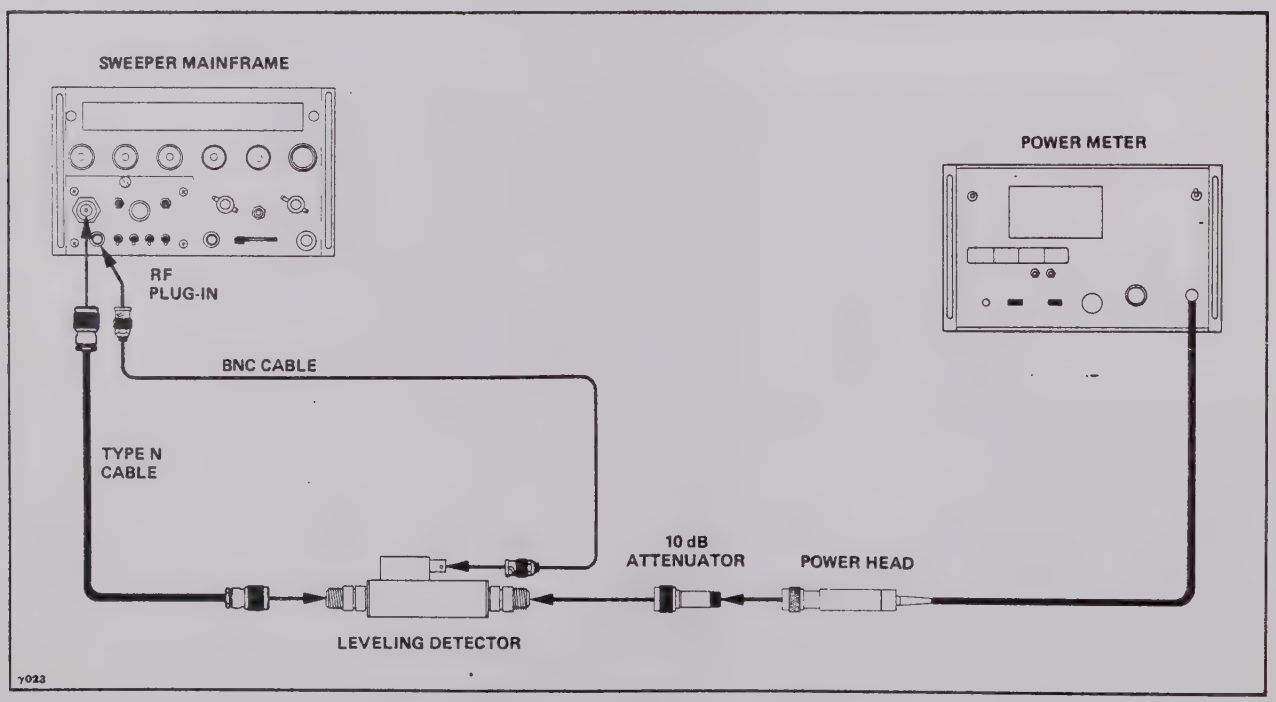


Figure 4-3. Test Setup for Output Power and External Leveling Flatness Performance Checks with External Directional Detector

12. Slowly rotate the **MANUAL SCAN** control through its range; observe the power reading and locate the frequency at which the output amplitude is lowest.

13. Adjust the **RF LEVEL** control for a power level of exactly 16 mW (+12 dBm). Because a 10-dB attenuator was used, the power meter reading will be 1.6 mW (+2 dBm).

14. Vary the **MANUAL SCAN** control over its full range again; check the power meter reading to ensure that the total power level increase over the band does not exceed 0.81 dB. This verifies the leveled flatness specification of $\leq \pm 0.4$ dB for the 5010 and the minimum output power specification of 20 mW for the 5010 when it is used with an external leveler with the characteristics of the recommended Model 1025.

IMPORTANT

This procedure does not allow for variations in the 10-dB attenuator. The worst-case combination of 5010, leveler, and attenuator error is $\leq \pm 0.75$ dB.

15. Adjust the **RF LEVEL** control to the **5 mW** marking and note the power meter reading.

16. Rotate the **RF LEVEL** control to the **10 mW** marking; verify the power meter reading increases by 3.0 ±0.6 dB from the reading in Step *15*.

17. Rotate the **RF LEVEL** control to the **20 mW** marking and verify the amplitude increases by 6.0 ±0.8 dB from the reading in Step *15*.

4-2.7 Unleveled Power Output and Flatness

4-2.7.1 DESCRIPTION. The peak output power amplitude is measured over the full frequency range of the plug-in to ensure conformance with minimum output power and flatness specifications.

4-2.7.2 PROCEDURE.

1. Connect the test equipment as shown in Figure 4-2.

2. Set the power meter to its 10 mW (+10 dBm) range (not necessary if Systron-Donner Model 4020A is used).

3. Set the **LEVELER** switch to **OFF**.

4. Set the **RF LEVEL** control to its maximum cw position; leave it at this position for the rest of the procedure.

5. Slowly vary the **MANUAL SCAN** control over its full range.

6. Set the power meter range switch to the position which allows the best resolution.

7. Check the power meter reading while manually scanning the entire band; note the maximum and minimum amplitudes.

8. Verify that the minimum power is $\geq$ 25 mW (+14 dBm). Because a 10-dB attenuator was used, the power reading will be $\geq$ 2.5 mW (+4 dBm).

9. Verify that the maximum power variation ($P_{max} - P_{min}$) does not exceed 4 dB.

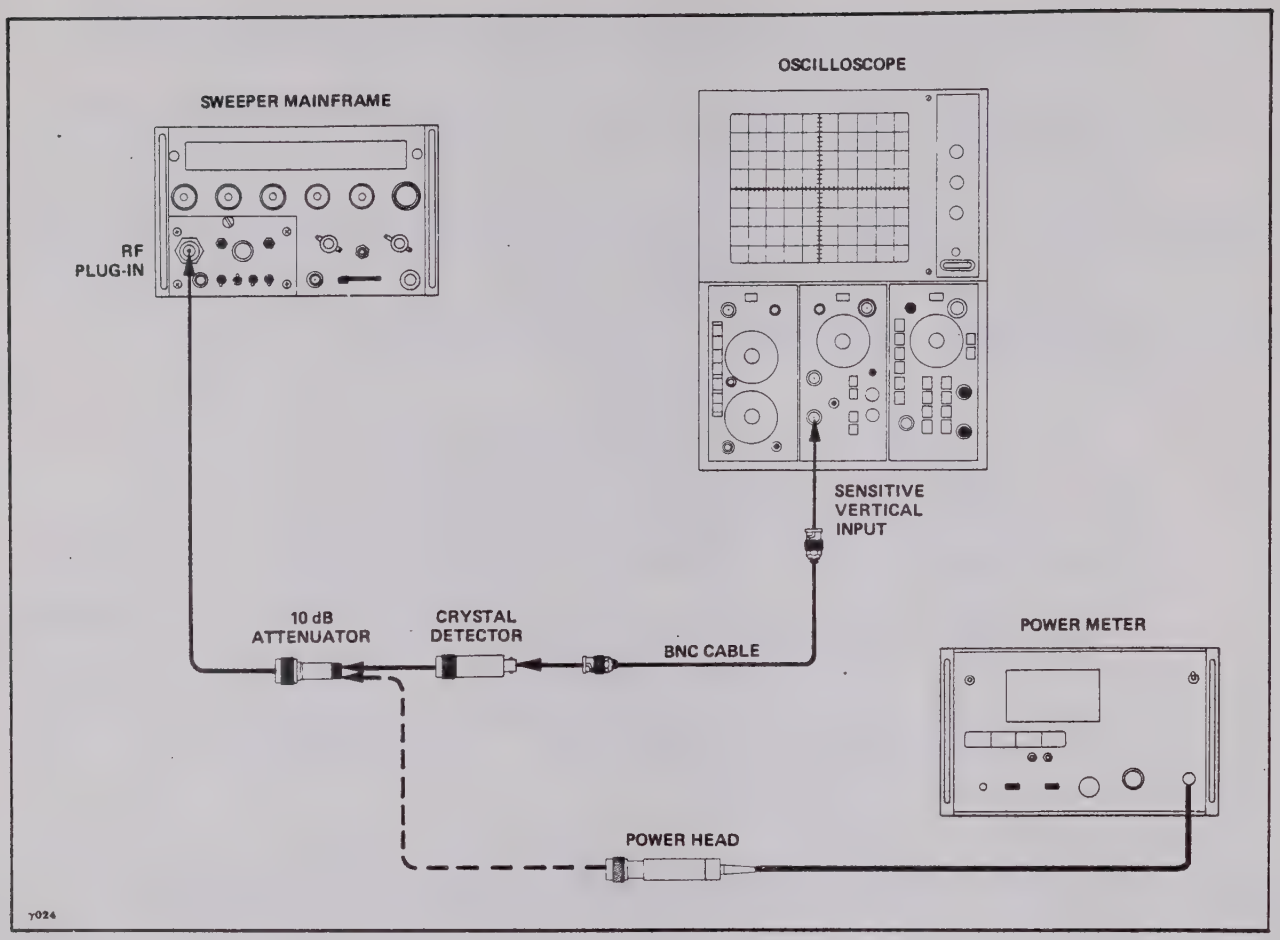


Figure 4-4 . Test Setup for Residual Amplitude Modulation Performance Check

4-2.8 Residual Amplitude Modulation

4-2.8.1 DESCRIPTION. The content of unwanted amplitude modulation of the RF output signal is measured to ensure that it is not in excess of the specified value.

4-2.8.2 PROCEDURE.

1. Set the **MODE** switch to **WIDE F1–F2**.
2. Set the **SWEEP SECONDS** switch to **MANUAL SCAN**.
3. Set the **F1–START** control so the **F1–START** frequency indicator is at 500 MHz.
4. Set the **F2–STOP** control so the **F2–STOP** frequency indicator is at 1,000 MHz.
5. Connect the test equipment as shown in Figure 4-4.
6. Set the oscilloscope bandwidth controls for a lower limit of dc and an upper limit of 100 kHz.

7. Set the oscilloscope time-base controls for an internally-generated free-running trace; use any convenient sweep rate.

8. Set the oscilloscope coupling to "ground" and carefully zero the trace.

9. Set the **LEVELER** and **RETRACE** switches to **OFF**.

10. Turn the **RF LEVEL** control fully cw.

11. Set the vertical sensitivity of the oscilloscope to 100 mV/Division.

12. Set the oscilloscope coupling switch to "dc".

13. Rotate the **MANUAL SCAN** control through its range to find the frequency at which the lowest power output occurs. Leave the **MANUAL SCAN** control in this position for the rest of this procedure.

14. Measure and note the dc amplitude of the detected RF output (V_O) at the minimum point.

15. Set the oscilloscope coupling switch to "ac" and the vertical sensitivity to 1 mV/Division.

16. Measure the peak-to-peak voltage of the detected waveform.

17. Divide the amplitude V_O noted in Step *14* by 200; verify that the signal level measured in Step *16* is *less* than this figure ($V_O \div 200 = 46$ dB).

18. Set the **RF LEVEL** control to **0**.

19. Set the **LEVELER** switch to **INT**. If the 5010 is not equipped with Option M2 Internal Leveling, use a Model 1025 external leveler and set the switch to **EXT**.

20. Remove the crystal detector from the output of the attenuator.

21. Connect a power meter to the output of the attenuator.

22. Adjust the **RF LEVEL** control for a power meter reading of 2 mW (+3 dBm). This sets the output level of the 5010 to the rated leveled output amplitude, taking the 10-dB attenuator into account.

23. Without changing the setting of the **RF LEVEL** control, disconnect the power meter from the output of the 10-dB attenuator and reconnect the crystal detector.

24. Set the oscilloscope coupling switch to "ground" and the vertical sensitivity to 50 mV/Division.

25. Carefully establish a zero trace reference, then set the oscilloscope coupling switch to "dc".

26. Set the **RETRACE** switch to **OFF**.

27. Measure and note the dc amplitude (V_O).

28. Set the oscilloscope coupling switch to "ac" and the vertical sensitivity to 1 mV/Division.

29. Measure the peak-to-peak value of the detected waveform.

30. Verify that the leveled mode residual AM index is at least 40 dB by dividing the amplitude V_o (Step 27) by 100 ($V_o \div 100 = 40$ dB).

4-2.9 Oscillator Pulling and Attenuation

4-2.9.1 DESCRIPTION. The amplitude of frequency change from minimum to maximum output amplitude is measured to ensure that it does not exceed the specified maximum.

4-2.9.2 PROCEDURE.

1. Set the **RF LEVEL** control to **0**.

CAUTION

BE SURE THE INPUT ATTENUATOR OF THE SPECTRUM ANALYZER IS SET TO 30 dB OR GREATER BEFORE PROCEEDING WITH STEP 2.

2. Connect the equipment as shown in Figure 4-5.

3. Set the spectrum analyzer input attenuator to 30 dB; this may be changed later.

4. Set the **MODE** switch to **CW**.

5. Adjust the **MARKER 2—Fc** control for a frequency of 750 MHz.

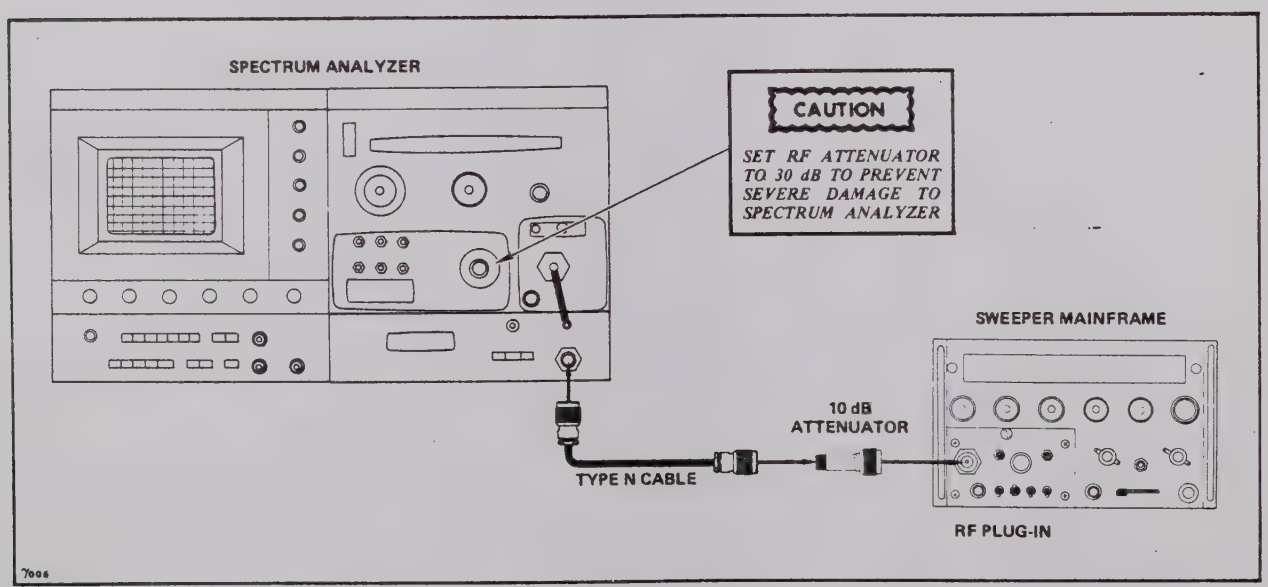


Figure 4-5. Test Setup for Spectrum Analyzer Checks

6. Set the **LEVELER** switch to **OFF**.

7. Rotate the **RF LEVEL** control fully cw.

8. Tune the spectrum analyzer to 750 MHz; adjust the RF and IF attenuators for a display of the carrier aligned with the logarithmic reference line of the analyzer display.

9. Adjust the spectrum analyzer controls to phase-lock the analyzer to the input signal.

10. Adjust the spectrum analyzer dispersion control(s) for 1 MHz/Division.

11. Carefully align the signal display with the center line of the spectrum analyzer horizontal axis.

12. Rotate the **RF LEVEL** control fully ccw.

13. Calculate the change in frequency. Verify the difference in frequency between maximum and minimum output amplitudes does not exceed 3 divisions. This is equivalent to a total change of 3 MHz at 750 MHz (±0.2%).

14. Verify the total amplitude change from maximum to minimum is at least 40 dB.

15. Set the **LEVELER** switch to **INT**. If the 5010 is not equipped with Option M2 Internal Leveling, use a Model 1025 external leveler and set the switch to **EXT**.

16. Verify the total amplitude change from maximum to minimum is at least 6 dB.

4-2.10 Residual Frequency Modulation

4-2.10.1 DESCRIPTION. The content of unwanted frequency changes in the continuous wave (CW) RF output signal is measured to ensure that it is below the allowable maximum.

4-2.10.2 PROCEDURE.

1. Set the **RF LEVEL** control to **0**.

2. Connect the equipment as shown in Figure 4-2.

3. Set the spectrum analyzer input attenuator to 30 dB; this may be changed later.

4. Set the **MODE** switch to **CW**.

5. Adjust the **MARKER 2—Fc** control for a frequency of 750 MHz.

6. Set the **SWEEP SECONDS** switch to **MANUAL SCAN**.

7. Set the **TRIG** switch to **MANUAL**.

8. Set the **RETRACE** switch to **ON**.

9. Set the **LEVELER** switch to **INT**. If the 5010 is not equipped with Internal Leveling Option M2, use a Model 1025 external leveler and set the switch to **EXT**.

10. Adjust the **RF LEVEL** control for a power meter reading of 2 mW (+3 dBm). This sets the output level of the plug-in to the rated leveled output amplitude, taking the 10 dB attenuator into account.

11. Without changing the setting of the **RF LEVEL** control, disconnect the power meter from the output attenuator.

CAUTION

BE SURE THE INPUT ATTENUATOR OF THE SPECTRUM ANALYZER IS SET TO 30 DB OR GREATER BEFORE PROCEEDING WITH STEP *12*.

12. Connect a cable between the output of the attenuator and the spectrum analyzer RF input (refer to Figure 4-5).

13. Tune the spectrum analyzer to 750 MHz; adjust the RF and IF attenuators for a display of the carrier aligned with the logarithmic reference line of the analyzer display.

14. Adjust the spectrum analyzer controls to phase-lock the analyzer to the input signal.

15. Adjust the spectrum analyzer dispersion control(s) for 2 kHz/Division.

16. Adjust the spectrum analyzer bandwidth control(s) to 30 kHz.

17. Set the sweep speed control(s) for a slow sweep, about 300 ms/Division.

18. As the spectrum analyzer CRT trace reaches the log reference level, measure the number of horizontal divisions covered by the trace at the logarithmic reference level; measure several cycles (refer to Figure 4-6).

19. Multiply the number of divisions covered by the trace at the peak level by the dispersion figure. Verify that the residual FM content is less than 2 kHz peak (less than 4 kHz peak-to-peak).

4-2.11 Spurious and Harmonic Content

4-2.11.1 DESCRIPTION. The content of unwanted spurious and harmonic outputs in the RF signal is measured to ensure conformance with the specified maxima.

4-2.11.2 PROCEDURE.

1. Set the **RF LEVEL** control to **0**.

2. Connect the equipment as shown in Figure 4-2.

3. Set the spectrum analyzer input attenuator to 30 dB; this may be changed later.

4. Set the **MODE** switch to **CW**.

5. Adjust the **MARKER 2—Fc** control for a frequency of 500 MHz.

6. Set the **SWEEP SECONDS** switch to **MANUAL SCAN**.

7. Set the **TRIG** switch to **MANUAL**.

8. Set the **RETRACE** switch to **ON**.

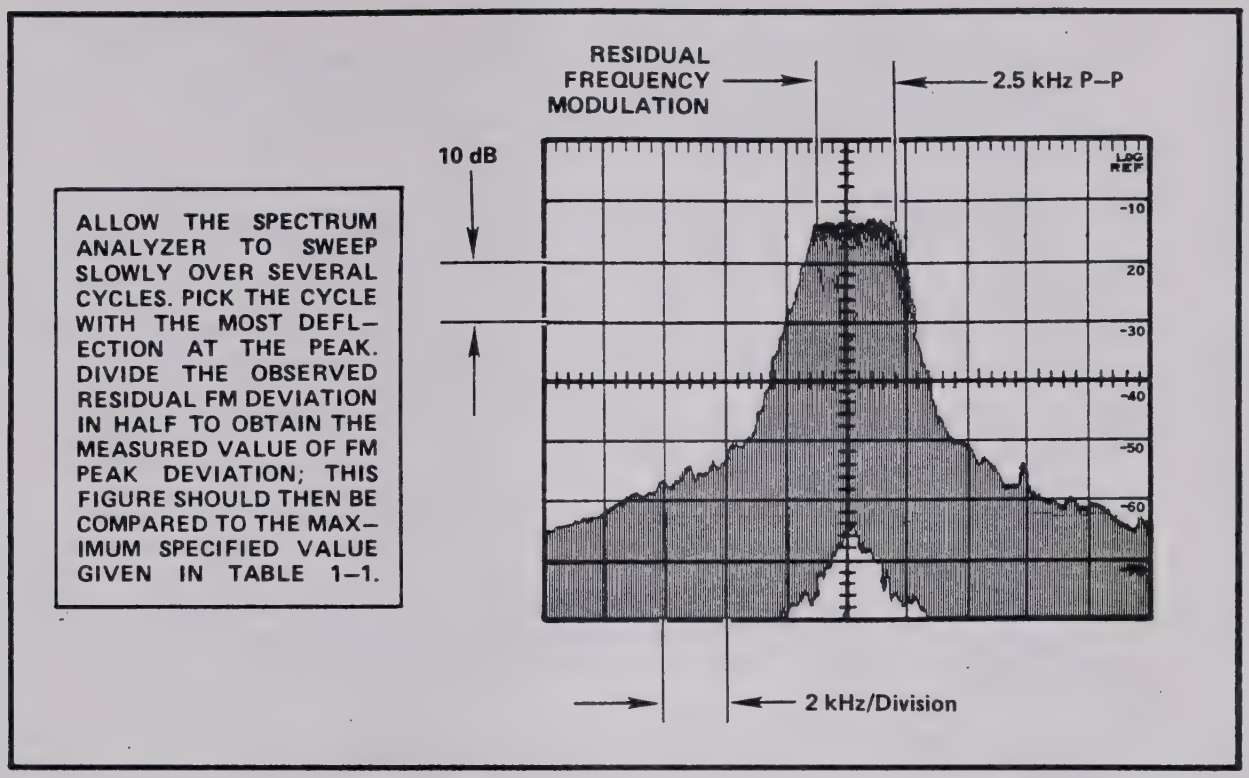


Figure 4-6. Typical Spectrum Analyzer Display of Residual FM

9. Set the **LEVELER** switch to **INT**. If the 5010 is not equipped with Option M2 Internal Leveling, use a Model 1025 external leveler and set the switch to **EXT**.

10. Adjust the **RF LEVEL** control for a power meter reading of 2 mW (+3 dBm). This sets the output level of the plug-in to the rated leveled output amplitude, taking the 10-dB attenuator into account.

11. Without changing the setting of the **RF LEVEL** control, disconnect the power meter from the output attenuator.

12. Connect a cable between the output of the attenuator and the spectrum analyzer RF input. (Refer to Figure 4-5.)

13. Tune the spectrum analyzer to 500 MHz; adjust the RF and IF attenuators for a display of the carrier aligned with the logarithmic reference line of the analyzer display.

IMPORTANT

Be sure the input signal amplitude is not excessive. Spurious products generated within the spectrum analyzer by excessive input levels will compromise measurement accuracy.

14. Adjust the spectrum analyzer dispersion control(s) for 1 MHz/division.

15. Tune the spectrum analyzer over the frequency range of 500 to 1,000 MHz; use the spectrum analyzer manufacturer's recommended signal identification procedures to determine that any observed signal within 60 dB of the log reference level is "real" and not a spurious response generated within the spectrum analyzer. Ignore responses within 1 MHz of the carrier frequency.

16. Verify that any spurious responses within the 500 to 1,000 MHz band which are not generated within the spectrum analyzer, and are not within 1 MHz of the carrier frequency, are ≥ 60 dB down from carrier level.

17. Tune the spectrum analyzer to 500 MHz; adjust the RF and IF attenuators for a display of the carrier aligned with the logarithmic reference line of the analyzer display.

18. Tune the spectrum analyzer to 1,000 MHz; verify the level of the second harmonic is ≥ 20 dB below the log reference level.

19. Tune the spectrum analyzer to 1,500 MHz and verify the level of the third harmonic is ≥ 20 dB down.

20. Adjust the **MARKER 2—Fc** control for a frequency of 1,000 MHz. Verify the second harmonic at 2,000 MHz and the third harmonic at 3,000 MHz are ≥ 20 dB below the carrier level.

4-2.12 Internal Amplitude Modulation

4-2.12.1 DESCRIPTION. The frequency and symmetry of the internal square wave generator are tested for conformance to specifications; square wave rise and fall times in the demodulated output are analyzed to ensure leveling loop response is within specification:

4-2.12.2 PROCEDURE.

1. Rotate the **RF LEVEL** control of the 5010 to its maximum ccw position.

2. Connect the equipment as shown in Figure 4-7, with the BNC cable connecting the rear-panel **1 KHZ** jack of the mainframe to the low-frequency input of the counter.

3. Set the **LEVELER** switch to **INT**. If the 5010 is not equipped with Option M2 Internal Leveling, use a Model 1025 external leveler and set the switch to **EXT**.

4. Set the **1 KHZ** switch to **ON**.

5. Set the mainframe **MODE** switch to **CW**.

6. Adjust the **MARKER 2—Fc** control for a mid-band output frequency, about 750 MHz.

7. Increase the setting of the **RF LEVEL** control to **20 mW**.

8. Rotate the **1 KHZ ADJ** control fully ccw. Verify the frequency is ≤ 950 Hz.

9. Rotate the **1 KHZ ADJ** control fully cw and verify the frequency is ≥ 1050 Hz.

10. Set the **1 KHZ ADJ** control to produce an output frequency of 1000 ±5 Hz.

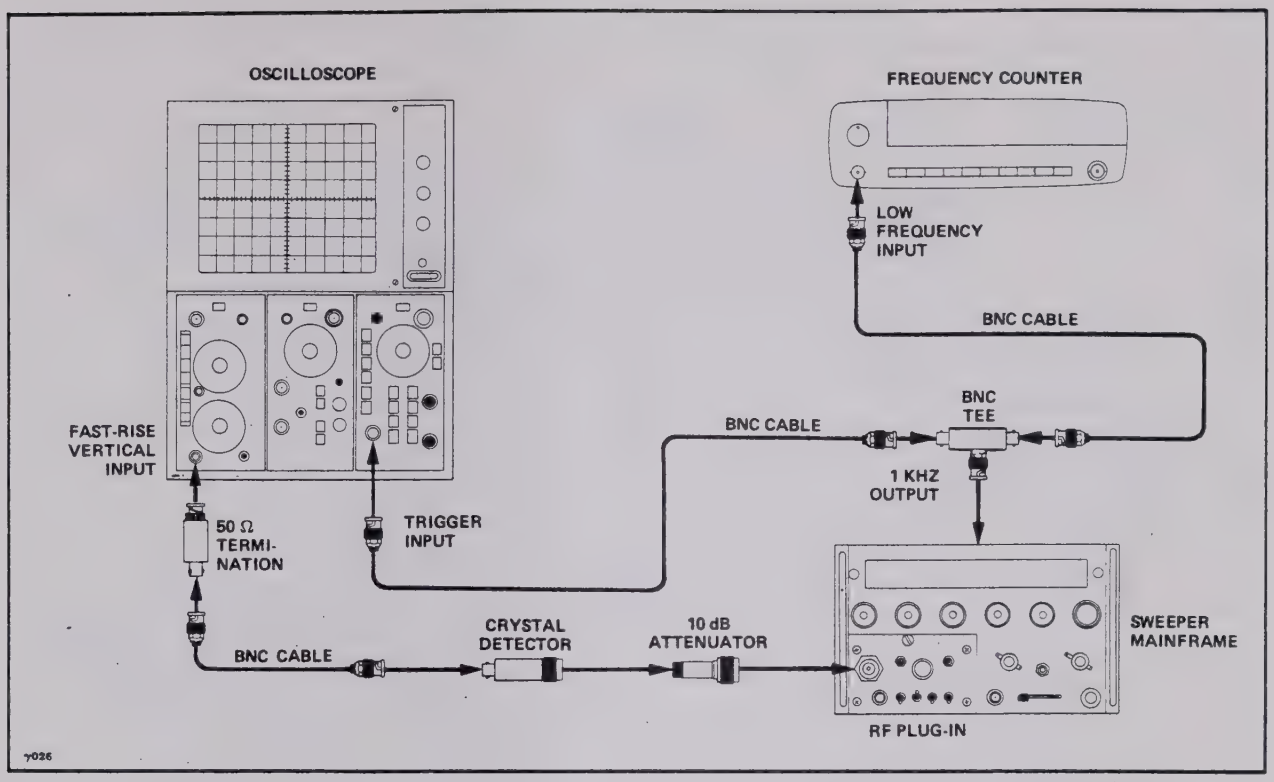


Figure 4-7. Test Setup for Internal Amplitude Modulation Performance Check

11. Move the 1 kHz input cable from the frequency counter to the "external trigger" input of the oscilloscope delaying time base.

12. Measure the 10% to 90% risetime of the leading edge of the detected 1 kHz square wave. Verify that T_r is $\leqslant 10\ \mu s$ (refer to Figure 4-8).

13. Verify that the 90% to 10% fall time of the trailing edge of the waveform is $\leqslant 10\ \mu s$, as shown in Figure 4-8.

14. Verify that the symmetry error of the detected square wave does not exceed 5%:

    a. Symmetry error (D) is defined as the percentage difference between the ratio of "on" time (T_{on}) less one-half the period time (T) of a single complete square wave cycle to one-half the period time (see Figure 4-8).

    b. Measure the total period time of one detected square wave.

    c. Measure the period of the "on" half of the cycle.

    d. Solve the equation:

$$D = \frac{T_{on} - 0.5\,T}{0.5\,T} \times 100$$

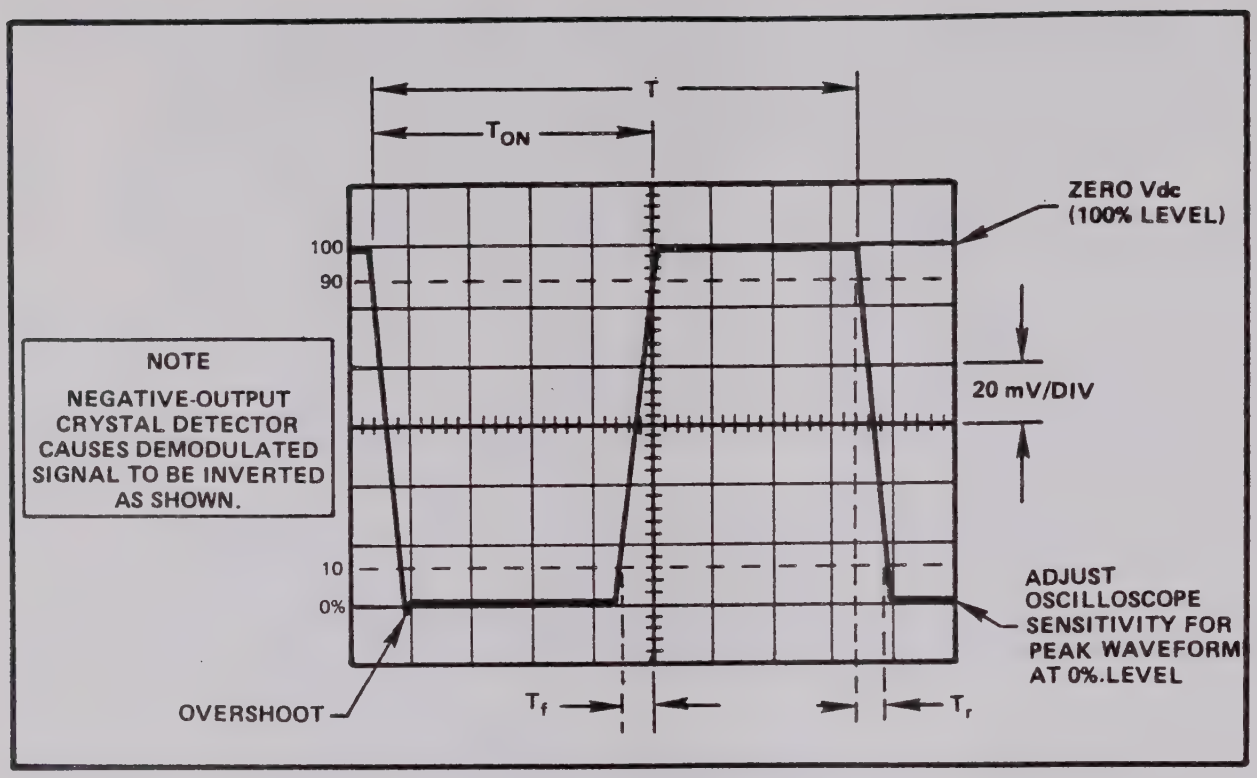


Figure 4-8. Demodulated Square Wave Characteristics

4-3. CALIBRATION

4-3.1 General

This paragraph contains instructions for calibrating the internal amplitude-modulation circuitry of the Model 5010 and — within very narrow limits — for calibrating the frequency-control circuits. These procedures are listed in Table 4-3.

Frequency linearization is required after repair or replacement of the oscillator module and may be necessary after the replacement of defective parts on the A1 Linearizer Printed Circuit Assembly. *THESE PROCEDURES MAY BE PERFORMED AT FACTORY LEVEL ONLY.*

The start and stop frequency limits may be calibrated in the field; if the intermediate frequency check points are out of specification following calibration of the start and stop frequencies, the 5010 must be returned to the factory for linearization.

4-3.2 Equipment Required for Calibration

Table 4-4 lists items of test equipment required for calibration of the 5010 RF Plug-in.

4-3.3 Access to Calibration Components

The 5010 should be opened as shown in Figure 4-9 to allow access to the components of printed circuit boards A1 and A2. The disassembly sequence is shown in Figure 4-10.

Table 4-3. Calibration Procedures

FUNCTION	CONTROL OR COMPONENT	LOCATION	REFERENCE PARAGRAPH
Oscillator Start Frequency Set	R37, R40	A1 Linearizer	4-3.6
Oscillator Stop Frequency Set	R77, R78	A1 Linearizer	4-3.6
Leveled Amplitude Zero	R7, R8	A2 Leveler	4-3.7
Leveled Amplitude Maximum	R67	A2 Leveler	4-3.7

Table 4-4. Test Equipment Required for Calibration

ITEM	TYPE OF EQUIPMENT	CHARACTERISTICS	RECOMMENDED MODEL*
1	Sweeper Mainframe	5010-compatible	Systron-Donner 5000A
2	Plug-in Extender	5010-compatible	Systron-Donner 9202
3	Frequency Counter	500 to 1,000 MHz	Systron-Donner 6243A
4	Digital Voltmeter	Resolution 1 mV on 10 V scale	Systron-Donner 7141A
5	RF Power Meter	500 to 1,000 MHz	Systron-Donner 4020A
6	RF Attenuator	10 dB, 500 to 1,000 MHz. Type N connectors	Systron-Donner 441A-10
7	RF Cable, 24"	50 Ω; BNC to BNC	ITT Pomona 2249-C-24
8	RF Adapter	N male to BNC female	ITT Pomona 3288
9	Decade Resistance Box	1 Ω to 1 MΩ ±1%	Heathkit IN-3117 (4 required)
10	Patch Cable, 24"	Dual Banana Plug to BNC	H.H. Smith 1584-24
11	Test Cable, 24"	Dual Banana Plug to miniature test clips	ITT Pomona 3786-C-24 (4 required)

**Equipment having equivalent characteristics may be substituted.*

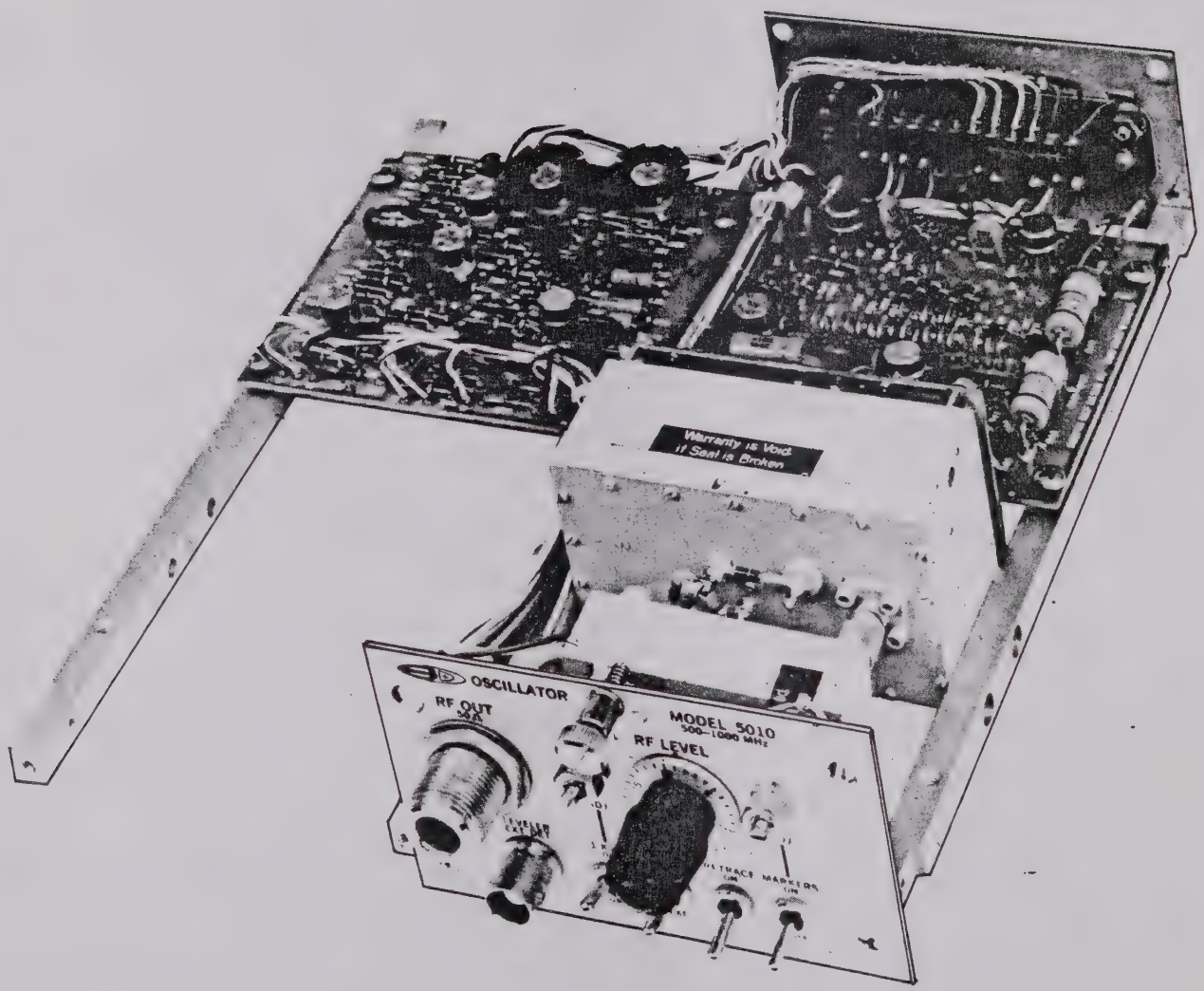


Figure 4-9. Service and Select-by-Test Calibration Configuration

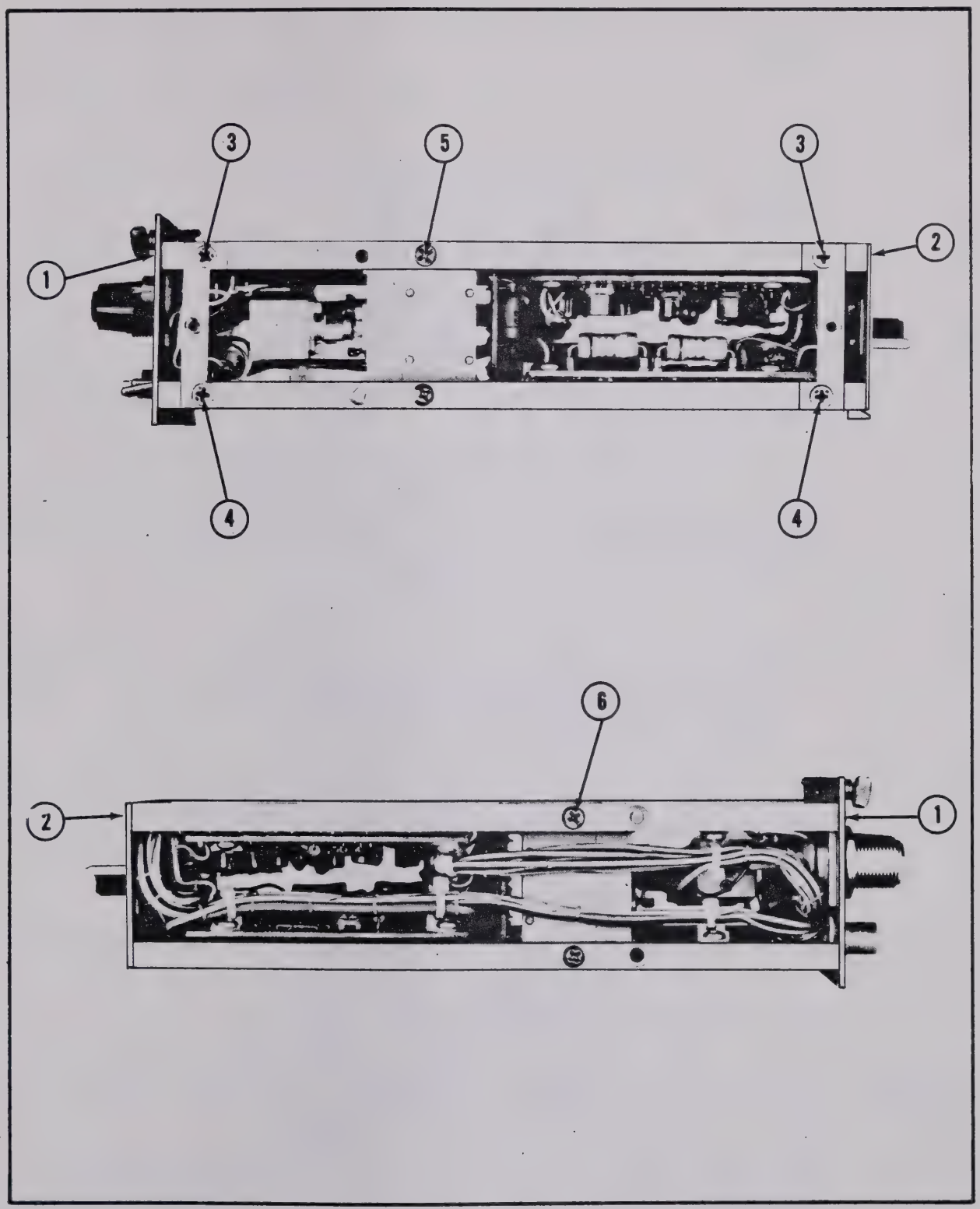


Figure 4-10. Disassembly Sequence for Service and Select-by-Test Calibration

1. Remove two No. 6-32 x 5/16 in. Oval-head Phillips screws (1) from the top of the front panel.

2. Remove two No. 6-32 x 5/16 in. Flat-head Phillips screws (2) from the top of the rear panel.

3. Remove two No. 6-32 x 3/16 in. Flat-head Phillips screws (3) from the left top mounting bar.

4. Loosen, but do not remove two Flat-head Phillips screws (4) from the left bottom mounting bar.

5. Remove one No. 6-32 x 5/16 in. Fillister-head Phillips screw (5) from the left top mounting bar.

6. Remove one No. 6-32 x 5/16 in. Fillister-head Phillips screw (6) from the right-top mounting bar.

7. Grasp the top mounting rails and gently pull up to clear the oscillator module.

8. Rotate the top mounting rails and A2 board assembly to the right side of the 5010. It may be necessary to cut one or more of the nylon cable ties so that the mounting rails and A2 can be fully rotated as shown in Figure 4-9.

CAUTION

USE CARE WHEN CUTTING THESE TIES TO AVOID NICKING OR CUTTING ANY OF THE WIRES. DO NOT STRAIN OR BREAK ANY WIRES SOLDERED TO THE A2 BOARD.

9. Attach the 5010 to the interface connector of the 9202 extender. In Model 5000A and some other mainframes, it may be necessary to remove the right-front corner block and handle if any interference is experienced when the 5010 is connected.

4-3.4 Location of Components and Adjustments

As an aid to calibration and repair, the locations of major components and subassemblies are shown in Figure 4-11.

4-3.5 General Procedure for Selection of Component Values

Paragraphs 4-3.6 and 4-3.7, following, contain test procedures which require the selection of fixed-value components to accomplish a particular calibration goal. These procedures may be completed more easily if simple practices are followed:

1. When a calibration resistor is removed and replaced with a resistance substitution box, it is generally best to cut the fixed resistor out of the circuit next to the body of the resistor. Use the resistor leads as connecting points for test leads from the resistance substitution box. This will avoid stressing the printed circuit board material and traces with repeated soldering/desoldering operations.

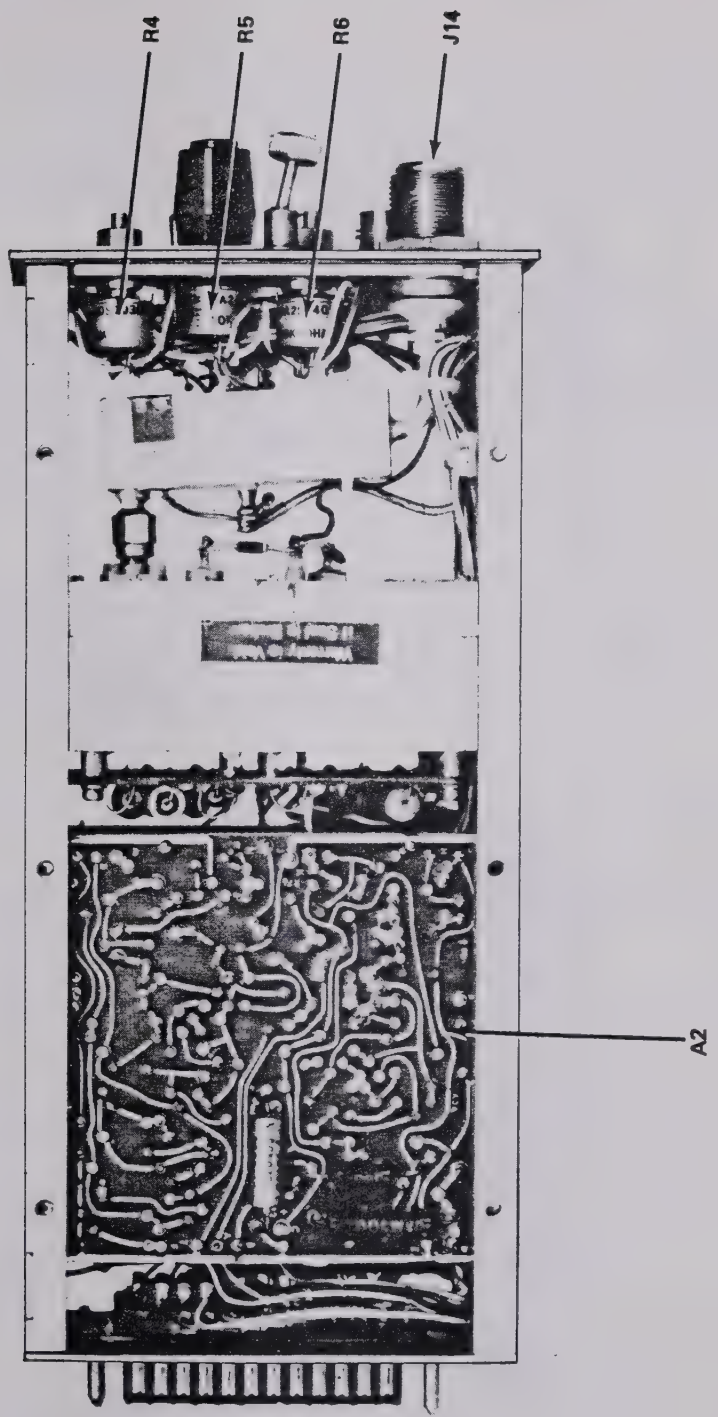


Figure 4-11. Location of Components — Top View (Sheet 1 of 2)

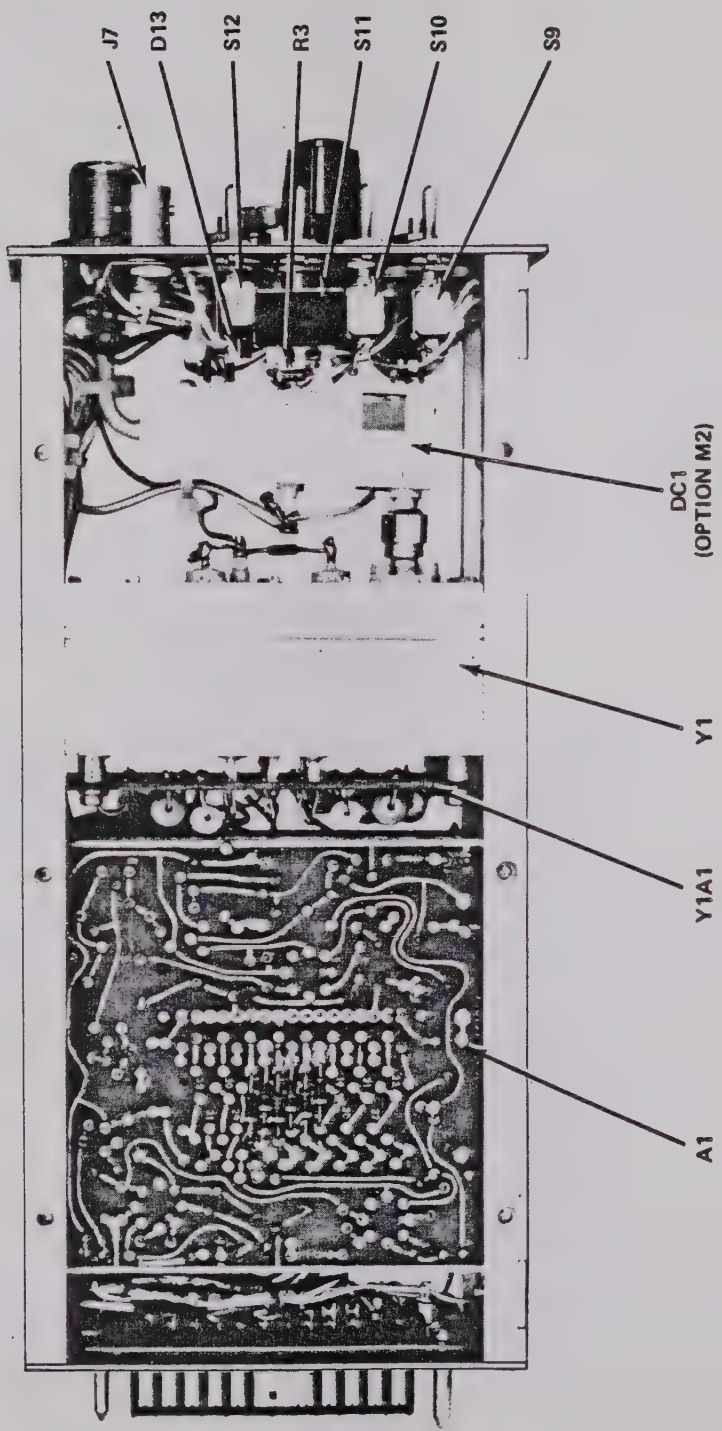


Figure 4-11. Location of Components — Bottom View (Sheet 2 of 2)

2. When determining resistance value with a decade box or resistance substitution box, always set the decade box value to a standard resistance value. Do not cause yourself unnecessary trouble by calibrating to unavailable component values.

3. Where two select-by-test calibration resistors are wired in parallel, one is used as a "trimming" value for the other. It is expected that one of the resistors will be set to a relatively low value (in terms of the other resistor) and the parallel resistance will be relatively high in value. Again, only standard resistance values should be used in this situation, although the resulting resistance value in the circuit of the two components will probably not be a standard value.

4-3.6 Calibration of Frequency Limits

4-3.6.1 DESCRIPTION. The minimum and maximum frequency limits may be calibrated in the field without specialized test equipment or test jigs. In some cases, it may be possible to calibrate an out-of-specification 5010 without returning it to the factory for linearization. It is often possible to recalibrate the frequency range of the 5010 after replacement of a defective linear component (such as one of the integrated circuit operational amplifiers) on the A1 linearizer board.

IMPORTANT

This procedure is useful for calibrating the low and high frequency limits only; if any of the intermediate points are out of specification after this procedure has been completed, the 5010 RF Plug-in must be returned to the address shown on page i of this manual for linearization.

4-3.6.2 PROCEDURE.

1. Put the 5010 in the *service/select-by-test calibration* configuration (refer to Paragraph 4-3.3).

2. Remove resistor A1R77 (Figure 4-12) and connect a resistance decade box in its place. Set the resistance value to 50 kΩ initially.

3. Remove resistor A1R78 (Figure 4-12) and connect a second resistance decade box in its place. Set the resistance value to 50 kΩ initially.

4. Remove resistor A1R37 (Figure 4-12) and connect the third resistance decade box in its place. Set the resistance value to match that of the resistor removed.

5. Remove resistor A1R40 (Figure 4-12) and connect the fourth resistance decade box in its place. Set the resistance value to match that of the resistor removed.

6. Install the Model 9202 Extender in the mainframe.

7. Mount the 5010 to the 9202; support the front of the 5010 with non-conductive material.

8. Connect the test equipment as shown in Figure 4-13 (Model 5000 or 5000A mainframe) or Figure 4-14 (Model 540 or 540B mainframe).

9. Select the mainframe's CW sweep mode.

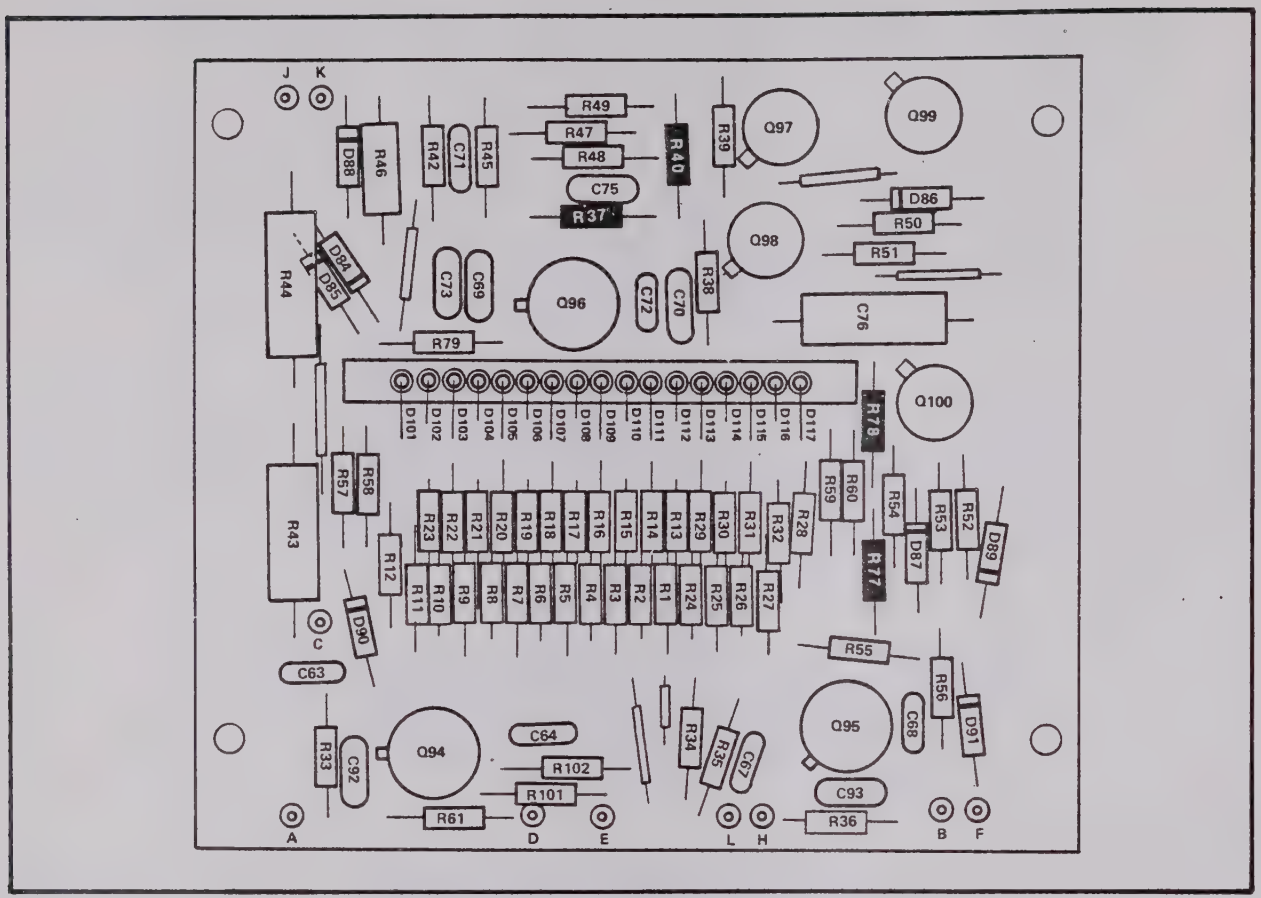


Figure 4-12. A1 Board Calibration Component Location

10. Set the 5010 **1 KHZ, MARKERS** and **RETRACE** switches to **OFF**.
11. Set the 5010 **LEVELER** switch to **INT**. If the 5010 is not equipped with Option M2 Internal Leveling, set the switch to **OFF**.
12. Rotate the **RF LEVEL** control fully cw.
13. Turn on the mainframe and all test equipment. Allow ≈ 15 minutes for warmup.
14. Set the **CW** control for a DVM reading of –0.625 ±0.005 Vdc.
15. Select resistance values for A1R37 and A1R40 which produce a counter reading of 500 ±2.5 MHz.

NOTE

Do not select a value below 5 kΩ for either resistor.

16. Set the **CW** control for a DVM reading of –9.375 ±0.005 Vdc.
17. Select standard resistance values for A1R77 and A1R78 which produce a counter reading of 1,000 ±2.5 MHz. The two resistors should be kept reasonably close in value (within ±10% of one another).

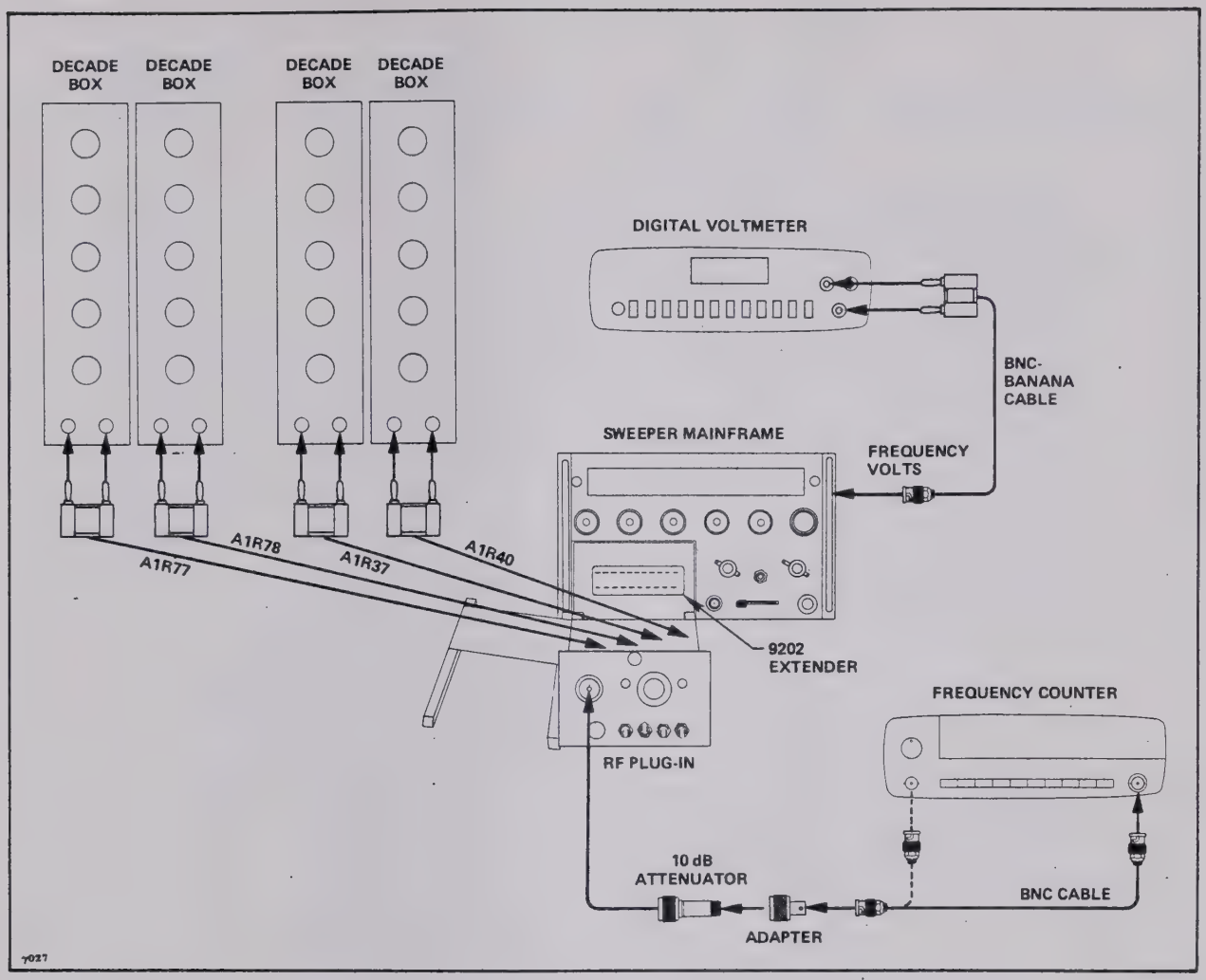


Figure 4-13. Test Setup for Frequency Range Calibration in Model 5000A Mainframe

18. Repeat Steps *15* through *17* as many times as necessary to produce an output frequency of 500 ±2.5 MHz at a voltage of –0.625 Vdc and 1,000 ±2.5 MHz at a voltage of –9.375 Vdc. *If these results cannot be achieved, the 5010 must be returned to the factory for linearization.*

19. Turn off mainframe power and remove the 5010.

20. Pick the standard resistor value closest to the decade box resistance settings for A1R37, A1R40, A1R77, and A1R78. The resistors must have the following characteristics:

    a. Metal film construction

    b. Tolerance of ±2%

    c. Wattage rating of ¼ W

    d. Temperature coefficient of ±9 PPM or less

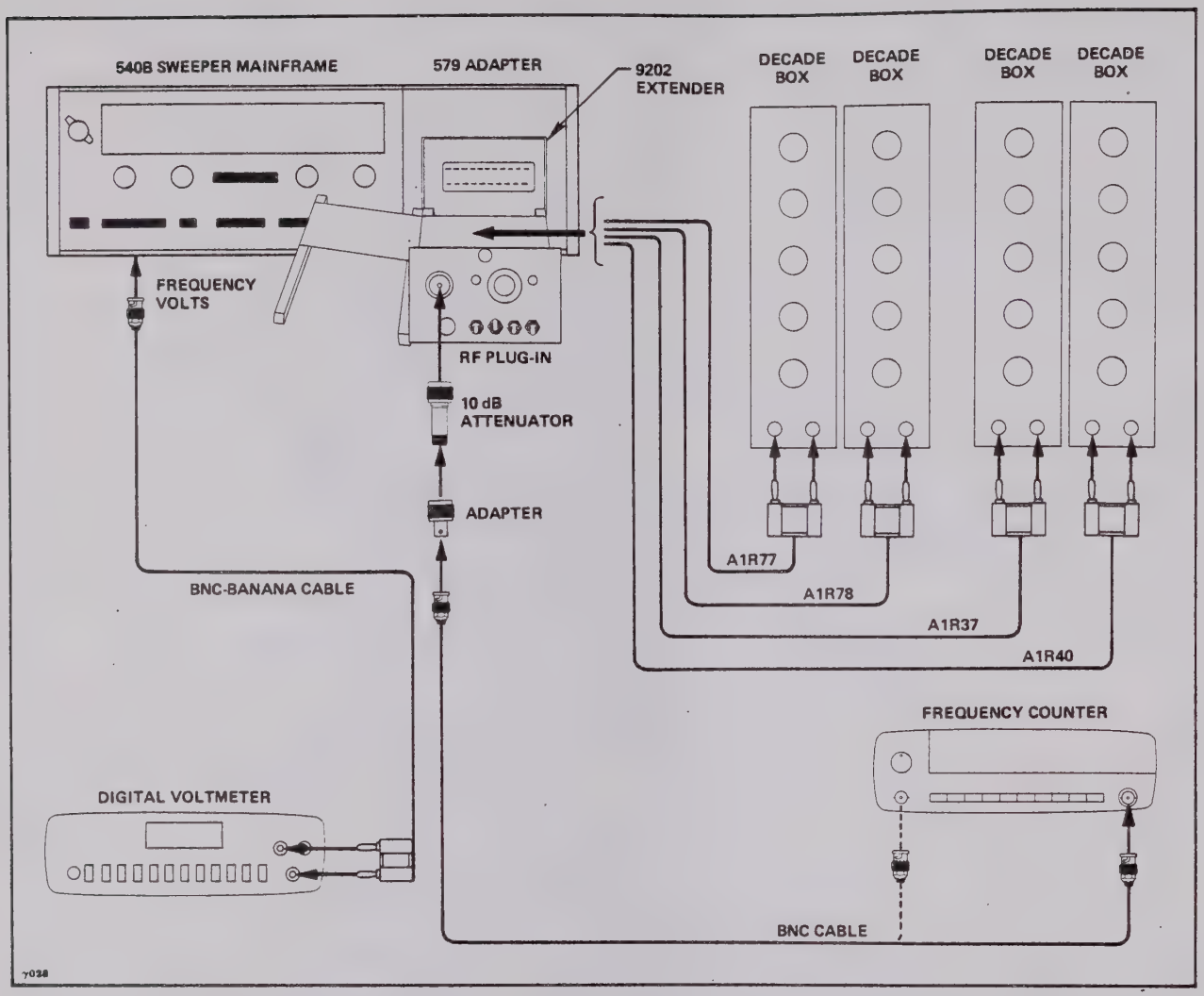


Figure 4-14. Test Setup for Frequency Range Calibration in Model 540B Mainframe/579 Adapter

21. Permanently solder the selected resistors in place.

22. Measure the frequencies of the intermediate check points as detailed in Table 4-5. *If any of the measured frequencies is more than ±5 MHz from the specified value, the 5010 must be returned to the factory for linearization.*

4-3.7 Leveled Amplitude Calibration

4-3.7.1 DESCRIPTION. Offset and gain resistors are selected to set the output amplitudes of the 5010 when the **RF LEVEL** control is set to **0** and **20 mW.**

4-3.7.2 PROCEDURE.

1. Put the 5010 in the *service/select-by-test calibration* configuration (refer to Paragraph 4-3.3)

Table 4-5. Frequency Calibration Check Points

FREQUENCY VOLTS	SPECIFIED FREQUENCY	TOLERANCE	RANGE
–0.100 Vdc	470 MHz	Not specified	—
–0.625 Vdc	500 MHz	±5 MHz	495 to 505 MHz
–1.080 Vdc	526 MHz	±5 MHz	521 to 531 MHz
–2.060 Vdc	582 MHz	±5 MHz	577 to 587 MHz
–3.040 Vdc	638 MHz	±5 MHz	633 to 643 MHz
–4.020 Vdc	694 MHz	±5 MHz	689 to 699 MHz
–5.000 Vdc	750 MHz	±5 MHz	745 to 755 MHz
–5.980 Vdc	806 MHz	±5 MHz	801 to 811 MHz
–6.960 Vdc	862 MHz	±5 MHz	857 to 867 MHz
–7.940 Vdc	918 MHz	±5 MHz	913 to 923 MHz
–8.920 Vdc	974 MHz	±5 MHz	969 to 979 MHz
–9.375 Vdc	1,000 MHz	±5 MHz	995 to 1,005 MHz
–9.900 Vdc	1,030 MHz	Not specified	—

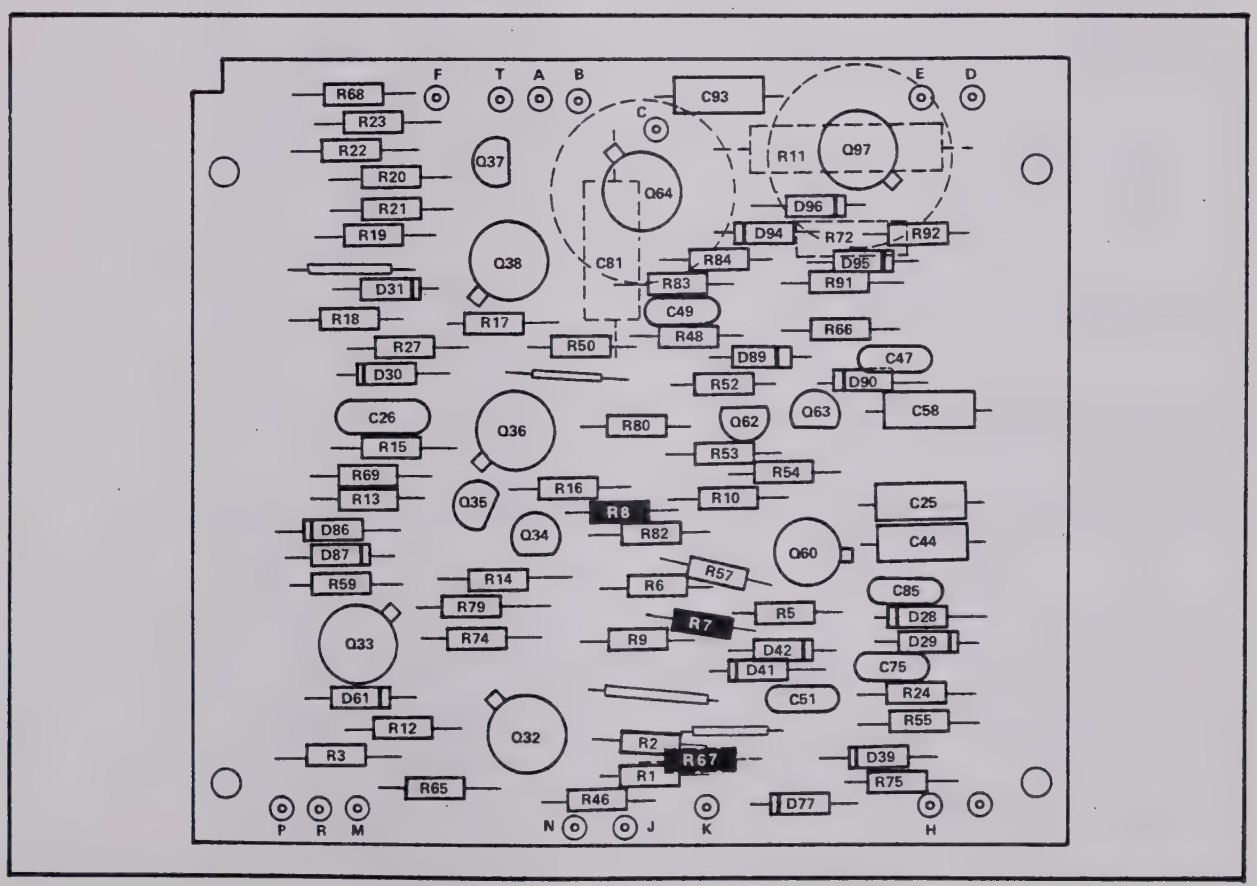


Figure 4-15. A2 Board Calibration Component Location

2. Remove resistors A2R7 and A2R8 (Figure 4-15) and connect separate resistance decade boxes in their places. Set both decade boxes to 150 kΩ initially.

3. Remove resistor A2R67 (Figure 4-15) and connect a resistance decade box in its place. Set the decade box to 1 MΩ.

4. Install the Model 9202 Extender in the mainframe.

5. Mount the 5010 to the 9202; support the front of the 5010 with non-conductive material.

6. Turn on mainframe power.

7. Select the CW mode of the mainframe.

8. Set the mainframe **CW** control to 750 MHz.

9. Connect the equipment as shown in Figure 4-16.

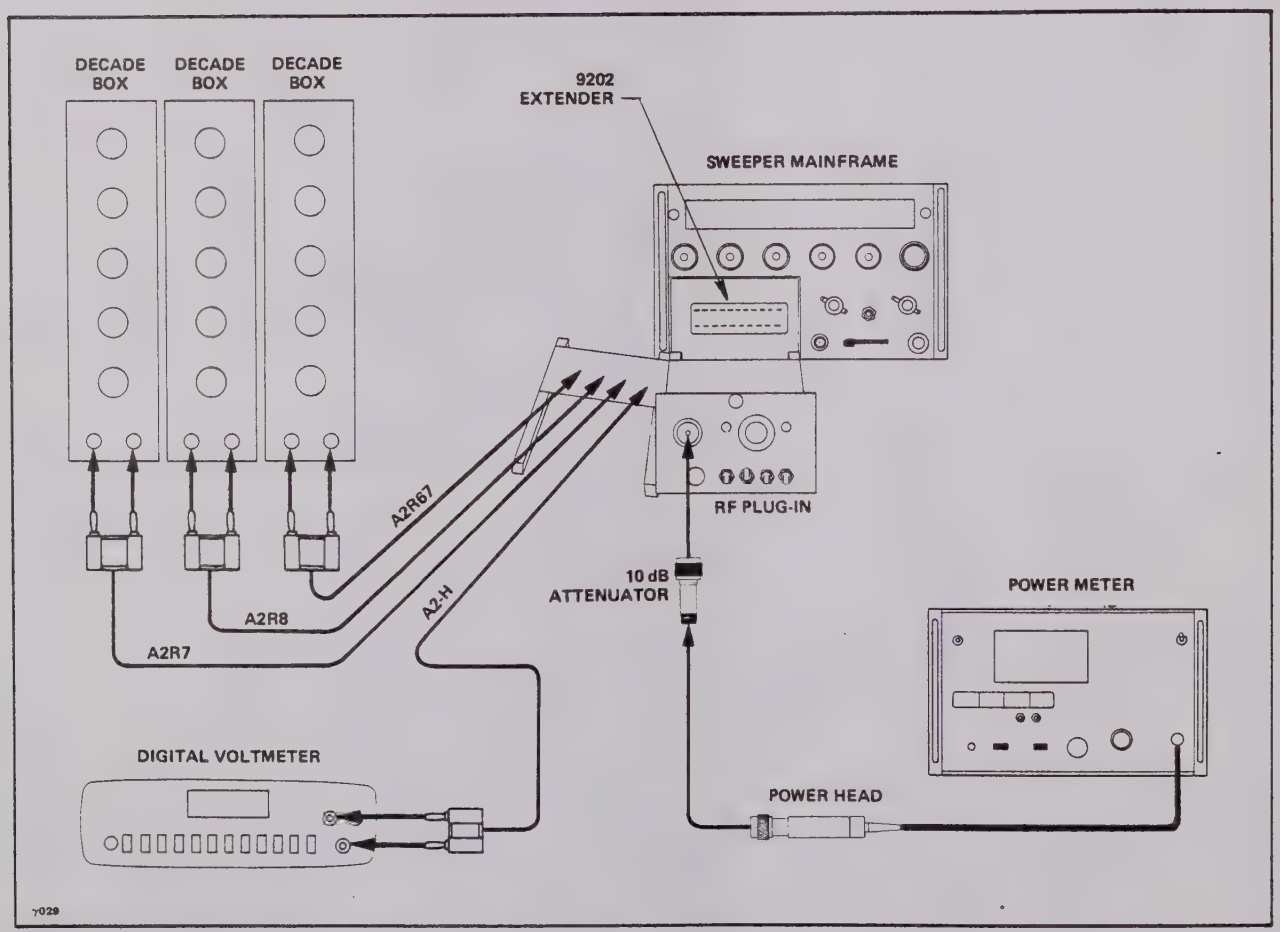


Figure 4-16. Test Setup for Leveling Loop Amplitude Calibration

10. Set the power meter to its 10 mW (+10 dBm) range (not necessary if Systron-Donner Model 4020A is used).

11. Connect the + lead of the DVM to A2-H (Figure 4-15).

12. Connect the – DVM lead to chassis ground.

13. Set the 5010 **LEVELER** switch to **OFF**.

14. Adjust the **RF LEVEL** control for a DVM reading of +30 ±5 mVdc.

15. If the dial is not at the **0** marking, loosen the two Allen-head set screws securing the knob to the shaft of the **RF LEVEL** potentiometer and reposition it.

16. Set the 5010 **LEVELER** switch to **EXT**; do not connect an external leveling or an external A.M. input to the 5010 or mainframe.

17. Rotate the **RF LEVEL** control fully ccw.

CAUTION

IN THE FOLLOWING STEP, DO NOT SET THE VALUE OF EITHER RESISTANCE SUBSTITUTION BOX LOWER THAN 1 kΩ. CIRCUIT DAMAGE COULD RESULT IF THIS PRECAUTION IS NOT OBSERVED.

18. Select standard resistance values for A2R7 and A2R8 so that the RF output amplitude "flips" from minimum to maximum as the **RF LEVEL** knob is rotated cw. The amplitude should "flip" when the **0** marking of the dial is opposite the indicator (+30 ±5 mVdc on the DVM).

19. Set the 5010 **LEVELER** switch to **INT**. If the 5010 is not equipped with Option M2 Internal Leveling, connect a Model 1025 external leveler and set the switch to **EXT**.

20. Rotate the **RF LEVEL** control so the dial is at **20 mW**.

21. Select a resistor value for A2R67 which produces an RF output amplitude of 20 ±1 mW (+13 ±0.2 dBm). Because a 10-dB attenuator was used, the power meter reading will be 2 ±0.1 mW (+3 ±.02 dBm).

22. Set the **RF LEVEL** control to **10 mW**. Verify the output amplitude is 10 ±1 mW (+10 ±0.2 dBm).

23. If necessary, select another value for A2R67 which produces an output amplitude of 20 ±1 mW (+13 ±0.2 dBm) at the **20 mW** marking and 10 ±1 mW (+10 ±0.2 dBm) at the **10 mW** marking.

24. Repeat Steps *16* through *23*.

25. Pick the standard resistor values closest to the decade box settings for A2R7, A2R8 and A2R67. The resistors must have the following characteristics:

    a. Metal film construction

    b. Tolerance of ±2%

    c. Wattage rating of ¼ W

    d. Temperature coefficient of ±9 PPM or less

26. Permanently solder the selected resistors in place.

SECTION V

MAINTENANCE

5-1. GENERAL

This section contains instructions for routine servicing and cleaning of the 5010 and for the isolation and repair of malfunctioning circuits and components.

5-2. ROUTINE MAINTENANCE

In normal laboratory environments, the 5010 requires only brief annual service. Ideally, the plug-in and the mainframe in which it is used should be serviced together. If the mainframe has an air filter, inspect it regularly and clean it whenever necessary. The plug-in should also be cleaned at regular intervals:

1. Turn off mainframe power.

2. Loosen the plug-in locking screw and remove the plug-in from the mainframe.

3. Inspect the unit carefully for loose screws, nuts, etc.; tighten any hardware requiring it.

4. Clean all dust and other foreign substances from the plug-in. Use a soft brush and low-pressure dry air. In severe cases, a zero-residue cleaner and degreaser such as trichlorotriflouroethane may be used. This compound is available in an aerosol container as "FD Contact Cleaner" (1638-16S) from Tech-Spray, Amarillo, Texas, or under Federal Stock Number 6850-00105-3084, Cleaning Compound, Solvent. The solvent is also available in liquid form as Genesolv® D from Allied Chemical Corporation.

5. This solvent or isopropyl alcohol may be used to clean residue or metal chips from the inside of the RF OUT connector.

6. Clean the contacts of the interface connector with isopropyl alcohol or FD Contact Cleaner.

7. Clean the dial scale with a clean, soft rag and a mild detergent solution. Do not use alcohol or solvent!

5-3. CALIBRATION

The Performance Checks of Paragraph 4-2 should be completed annually. The referenced procedure is found in Section IV of this manual.

5-4. CORRECTIVE MAINTENANCE

5-4.1 Trouble Isolation

5-4.1.1 TROUBLE ISOLATION PROCESS. The Performance Checks of Section IV provide the principal means of determining that electrical performance of the 5010 is within specified parameters. In the event of evident failure or malfunction, certain logical steps must be followed and decisions made to effect repair or correct a malfunction within the shortest period possible. The basic process may be summarized as follows:

1. Does a malfunction in fact exist, or is an evident malfunction the result of incorrect switch or control positioning, incorrect external input signals, or misapplication of the sweeper/plug-in system?

2. If a malfunction does exist, is the fault in the plug-in or in the mainframe?

3. If the malfunction is within the plug-in, in which circuit or circuits is it located?

4. Which components within the affected circuits have malfunctioned?

5. What caused the malfunction, and will simple replacement of faulty components solve the problem permanently?

5-4.1.2 OPERATING VOLTAGES. Table 5-1 lists the operating voltages found at various points throughout a normally-operating 5010 plug-in. If the voltages measured during trouble isolation procedures vary considerably from those listed, a malfunctioning component or broken wire is indicated.

5-4.1.3 SUPPORTING INFORMATION. The voltage information in Table 5-1 should be used in conjunction with the following information:

1. The detailed circuit descriptions and block diagrams in Sections VI, VIII, and IX.

2. The schematic diagrams and board component-location drawings in Sections VIII and IX and the chassis wiring diagram in Section VII.

3. The basing diagrams of multi-lead semiconductor devices used in the plug-in, shown on the wiring diagram of the 5010 (Figure 7-2), the A1 board assembly (Figure 8-6), the A2 board assembly (Figure 9-3), or the A3 board assembly (Figure 9-4).

4. The subassembly and component location information in Figures 4-11 and 7-1.

Table 5-1. Model 5010 Voltage Chart

MEASUREMENT POINT		CONDITIONS	TEST INSTRUMENT	NORMAL VOLTAGE	TOLERANCE
FROM	TO				
Y1-1	Y1-5	All	DVM	+20 Vdc	±20 mVdc
Y1-2	Y1-5	All	DVM	–20 Vdc	±20 mVdc
Y1-3	Y1-5	CW frequency set to 470 MHz	DVM	+100 mVdc	±200 mVdc
Y1-3	Y1-5	CW frequency set to 1030 MHz	DVM	+65 Vdc	±7 Vdc
Y1-4	GND	**RF LEVEL** at **0**	DVM	0 V	±0.5 V
Y1-4	GND	**RF LEVEL** at **20 mW**	DVM	–5 V	±1 V
Y1-7	GND	No phase lock input	DVM	≈ 0 V	
DC1-1	GND	20 mW output, **LEVELER** to **INT** (5010M2 only)	DVM	–200 mV	±10 mV

Table 5-1. Model 5010 Voltage Chart (Continued)

MEASUREMENT POINT		CONDITIONS	TEST INSTRUMENT	NORMAL VOLTAGE	TOLERANCE
FROM	TO				
A1-A	GND	All	DVM	+20 Vdc	±20 mVdc
A1-F	GND	All	DVM	–20 Vdc	±20 mVdc
A1-C	GND	All	DVM	+250 Vdc	±25 Vdc (not regulated)
A1-D	GND	CW frequency set to 470 MHz	DVM	–100 mVdc	±10 mVdc
A1-D	GND	CW frequency set to 1030 MHz	DVM	–9.90 Vdc	±50 mVdc
A1-B	GND	F1-F2, ΔF	DVM	≈ 0 V	
A1-B	GND	Manual Scan	DVM	+5.5 V	±1.5 Vdc
A1-B	GND	CW	DVM	+4.5 V	+2, –1.5 Vdc
A1-J	GND	CW frequency set to 470 MHz	DVM	+100 mVdc	±200 mVdc
A1-J	GND	CW frequency set to 1030 MHz	DVM	+65 Vdc	±7 Vdc
A2-A	GND	No Ext'l A.M. Input	DVM	0 V	
A2-B	GND	All	DVM	–20 Vdc	±20 mVdc
A2-C	GND	All	DVM	+20 Vdc	±20 mVdc
A2-D	GND	All	DVM	+30 V	±100 mVdc
A2-F	GND	**1 KHZ** set to **ON**	Scope	1 kHz sq wave ≈ +2 V peak	±50 Hz, ±0.2 V
A2-F	GND	**1 KHZ** set to **OFF**	Scope	≈ 0 V	
A2-H	GND	**RF LEVEL** at **0**, **LEVELER** at **INT** (5010M2)	DVM	≈ 0 V	
A2-H	GND	**RF LEVEL** at **20 mW**, **LEVELER** at **INT** (5010M2)	DVM	+5 V	±2 V
A2-J	GND	**RF LEVEL** at **20 mW**, **LEVELER** at **INT** (5010M2)	DVM	≈ 0 V	
A2-J	GND	**RF LEVEL** at **20 mW**, **LEVELER** at **OFF**	DVM	–0.50 Vdc	±0.25 Vdc
A2-K	GND	**RF LEVEL** at **20 mW**, **LEVELER** at **INT** (5010M2)	DVM	≈ 0 V	
A2-M	GND	**MARKER** to **ON**, **MARKER ADJ** max CW	Scope	–1 V pulses	±0.2 V pk
A2-N	GND	**LEVELER** at **INT** (5010M2)	DVM	+5 V	±2 V
A2-P	GND	**1 KHZ** to **ON**, **1 KHZ ADJ** centered	DVM	+10 Vdc	±1 Vdc
A2-R	GND	**1 KHZ** to **ON**	DVM	+20 Vdc	±20 mVdc
A2-S	GND	**RF LEVEL** at **0**	DVM	0 V	±0.5 V
A2-S	GND	**RF LEVEL** at **20 mW**	DVM	–5 Vdc	±1 Vdc
A2Q33-B	GND	**1 KHZ** to **OFF**, **RETRACE** to **OFF**, **WIDE F1-F2** mode, forward sweep	Scope	≈ 0 V	
A2Q33-B	GND	**1 KHZ** to **OFF**, **RETRACE** to **OFF**, **WIDE F1-F2** mode, sweep retrace	Scope	+5 V pulse	±1.5 V

5-4.2 Test Equipment

The calibration test equipment listed in Table 4-4, Section IV, should be used for trouble isolation.

CAUTION

BE VERY CAREFUL WITH OSCILLOSCOPE AND VOLTMETER PROBES TO AVOID ACCIDENTALLY BRIDGING TWO POINTS OR SHORT-CIRCUITING A WIRE OR COMPONENT LEAD TO GROUND. LACK OF ADEQUATE CARE WITH SEMICONDUCTOR AND INTEGRATED CIRCUITS CAN TURN RELATIVELY MINOR PROBLEMS INTO COSTLY EXPERIENCES.

Systron-Donner Extender Model 9202 and Plug-in Inverter Model 9203 are required for trouble isolation and repair of the plug-in. Flexible extension 109618 may be used in place of Model 9202 and Model 9203.

5-4.3 Printed Circuit Board Repair

Repair of the plug-in comprises location and replacement of defective components. To avoid damage to the printed circuit boards and precision components, solder or remove components only with a low-power (25 to 50 W, 500 to 650°) soldering iron. Do not use soldering guns or large irons. Use only 60-40 or 63-37 rosin core solder. To remove the integrated circuit operational amplifiers or other multi-lead devices, use a special iron tip that unsolders all leads at the same time (available from Ungar and other manufacturers). Remove excess solder from circuit board holes with a vacuum de-soldering device (available from Edsyn, Ungar, Wen, Viking, etc.).

5-4.5 Component Removal and Re-assembly

Refer to Paragraph 4-3.3, Section IV, for instructions to place the plug-in in its *service and select-by-test calibration* configuration. For disassembly to a greater depth, use the *Illustrated Parts Breakdown* — Figure 7-1 of Section VII — as a guide to disassembly and reassembly sequences.

Use the following method to assure reliable mating and low VSWR when reassembling the SMA connector pairs used inside the 5010:

1. Remove metal particles or other foreign material from both connectors using a Q-Tip® moistened with isopropyl alcohol.

IMPORTANT

Do not use aromatic or chlorinated hydrocarbons, esters, ethers, terpenes, higher alcohols, ketones, or ether-alcohols such as benzene, toluene, turpentine, dioxane, gasoline, cellosolve acetone, or carbon tetrachloride. Keep exposure of the connector parts to the alcohol and its vapors as brief as possible.

2. Remove all alcohol from the connectors and allow them to dry thoroughly.
3. Mate the connectors straight on and tighten with hand pressure only. Disconnect and inspect the pair if unusual resistance is felt as the connectors are being mated; the center conductor may be misaligned.
4. Tighten the connector nut to 8 ±1 inch-pounds with a 5/16 inch torque wrench.

5-4.5 Oscillator Module Repair and Replacement

Oscillator module Y1 is a sealed assembly and cannot be repaired in the field. If a malfunction has occurred within the oscillator module or if it has been damaged by an external malfunction, the entire 5010 RF Plug-in should be returned to the factory for repair and recalibration. Most oscillator modules can be repaired at considerably lower cost than that of a replacement oscillator module.

An oscillator module which is to be stocked as a spare part should be ordered with a matched RF output cable or Option M2 directional detector and a precalibrated linearizer board. The new A1 linearizer board must be installed in the 5010 when the oscillator is replaced.

IMPORTANT

The oscillator, RF output cable or Option M2 directional detector, and linearizer assembly must be kept together at all times. The output frequency of the 5010 will not be within specified limits if the matched linearizer and oscillator are not used together.

Use the nomenclature shown below to order the matched assemblies as spares:

FOR 5010: SPARE RF KIT 948601 / LINEARIZER 950213 MATCHED ASSY
FOR 5010M2: SPARE RF KIT 948578 / LINEARIZER 950213 MATCHED ASSY

5-5. MODIFICATIONS AND OPTIONS

5-5.1 Option M2, Internal Leveling

This option is installable at factory level only. Current production versions of Model 5010 include Option M2 unless they have been specifically ordered without it.

5-5.2 Option M3, Fast Amplitude Modulation

This option is installable at factory level only.

5-5.3 Option M3A, Fast Amplitude Modulation

This option is installable at factory level only.

5-5.4 Option M6, Constant Sensitivity Phase Lock

The user may modify the 5010 plug-in to this configuration whenever the constant sensitivity phase lock deviation capability is desired. Refer to Table 1-1 (Section I) for applicable performance specifications, to Figure 4-11 (Section IV) for component location information, and to wiring diagram Figure 7-2 (Section VII):

1. Place the RF plug-in in the *service and select-by-test calibration* configuration described in Paragraph 4-3.3, Section IV.

2. Locate the gray twin-conductor shielded cable connected to terminals 6 and 7 of the oscillator module.

3. Disconnect the black wire originating at P20-10 from terminal 7.

4. Disconnect the red wire originating at P20-11 from terminal 6.

5. Disconnect the clear shield wire from terminal 6.

6. Insulate the ends of the wires removed in Steps *3* through *5* and tie them into the wire harness.

7. Disconnect the black wire from P20-10.

8. Disconnect the red wire from P20-11.

9. Insulate the ends of the wires removed in Steps *7* and *8* and tie them into the wire harness.

10. Solder a 2 inch (5 cm) red wire from P20-11 to terminal **L** of printed circuit assembly A1.

11. Solder a 2 inch (5 cm) black wire from P20-10 to terminal **H** of printed circuit assembly A1.

12. Solder a short piece of bus wire between terminals 6 and 7 of the oscillator module.

13. Re-assemble the plug-in; install new cable straps if any were removed during the modification.

14. The phase lock input will now tune the oscillator at a constant sensitivity of 5 MHz/V, unaffected by frequency. It is important that the **PHASE LOCK** connector on the rear panel of the mainframe be kept short-circuited when not in use by removing the mating plug completely or by inserting a shorting plug. Do not leave an unterminated input cable attached to the **PHASE LOCK** connector.

5-5.5 Option M7, Negative Power Meter Leveling

This option is installable at factory level only.

5-5.6 Option M7A, Positive Power Meter Leveling

This option is installable at factory level only.

5-5.7 Option M9, Power Calibration in dBm

This option requires the installation of a replacement **RF LEVEL** knob and dial (Systron-Donner part number 94800415) and may be easily accomplished in the field. Check dial calibration after installation of the replacement knob.

1. Perform Steps *4* through *8* of Paragraph 4-3.7.2.

2. Connect the equipment as shown in Figure 4-2.

3. Set the power meter to its 10 mW (+10 dBm) range (not necessary if a Systron-Donner Model 4020A is used).

4. Set the 5010 **LEVELER** switch to **EXT**; do not connect an external leveling or an external AM input to the 5010 or mainframe.

5. Verify the RF output amplitude "flips" from minimum to maximum as the **RF LEVEL** knob is rotated. The power should "flip" when the **RF LEVEL** dial is about halfway between the **0** marking and maximum ccw rotation.

6. Set the 5010 **LEVELER** switch to **INT**. If the 5010 is not equipped with Option M2 Internal Leveling, connect Model 1025 external leveler and set the switch to **EXT**.

7. Set the **RF LEVEL** control to +13 dBm; verify the output amplitude is +13 ±0.4 dBm.

8. Set the **RF LEVEL** control to +10 dBm; verify the amplitude is +10 ±0.4 dBm.

9. If recalibration is required, perform the procedure of Paragraph 4-3.7.

SECTION VI

THEORY OF OPERATION

6-1. OVERALL FUNCTIONAL DESCRIPTION (Figure 6-1)

Figure 6-1 is a simplified block diagram of the Model 5010 RF Plug-in. The user is also referred to the mainframe instruction manual, which describes the interconnections and interrelationships between the mainframe and the RF plug-in.

The RF plug-in accepts operating power, frequency-control signals, and amplitude-control signals from the mainframe and generates a predictable band of radio-frequency energy to be used for transmission and/or reflection tests of instruments, systems, or components designed for operation in the 500 to 1,000 megahertz range.

6-1.1 Linearizer

Linearizer printed circuit assembly A1 accepts the tuning output of the mainframe and sums this voltage with externally-supplied frequency modulation (FM) voltage (Option M6 only). The tuning voltage is processed through a diode shaping network to provide the oscillator module with an exponential frequency-control voltage to match its non-linear tuning characteristics. The diode shaper in each 5010 is individually calibrated to match the characteristics of the oscillator.

Detailed circuit theory for Linearizer A1 is contained in Section VIII of this manual.

6-1.2 Amplitude Modulation Functions

Amplitude modulation signals from the mainframe (retrace blanking and markers) and external amplitude modulation signals coupled through the mainframe are summed with leveling feedback signals from an external detector or power meter to control the RF output amplitude of the plug-in. Other drive signals generated within the plug-in (power, leveling mode, and 1 kilohertz modulation) also provide drive for the RF modulator within oscillator Y1.

A directional detector included in all 5010's with Option M2 provides voltage feedback proportional to output power which may be used as an output amplitude leveling control signal, or a leveling signal from an external directional detector may be connected. Model 5010's equipped with Option M7 or M7A accept the output of a microwave power meter as a leveling input.

Detailed circuit theory for Leveler A2 is contained in Section IX of this manual.

6-2. OSCILLATOR (Figure 6-2)

The oscillator used in the 5010 is a patented varactor-tuned source of solid-state design and construction. The octave range of the oscillator is tuned by varactor diodes (voltage-variable capacitors) in a series-resonant tank circuit mounted in a machined cavity. Two oscillator transistors are used, connected in a push-pull configuration.

The RF energy circulating in the cavity is coupled to the RF modulator through a pickup loop which protrudes into the cavity. The modulator controls the output amplitude of the oscillator by acting as a voltage-variable attenuator using PIN diodes in a series configuration.

A PIN diode is manufactured so that a thin intrinsic region separates the P material from the N material. The storage time of the PIN diode is relatively long, so it does not rectify at radio frequencies. Instead, it behaves as a variable resistance controlled by a dc current through the diode. The control current is supplied by the leveler circuits of the 5010.

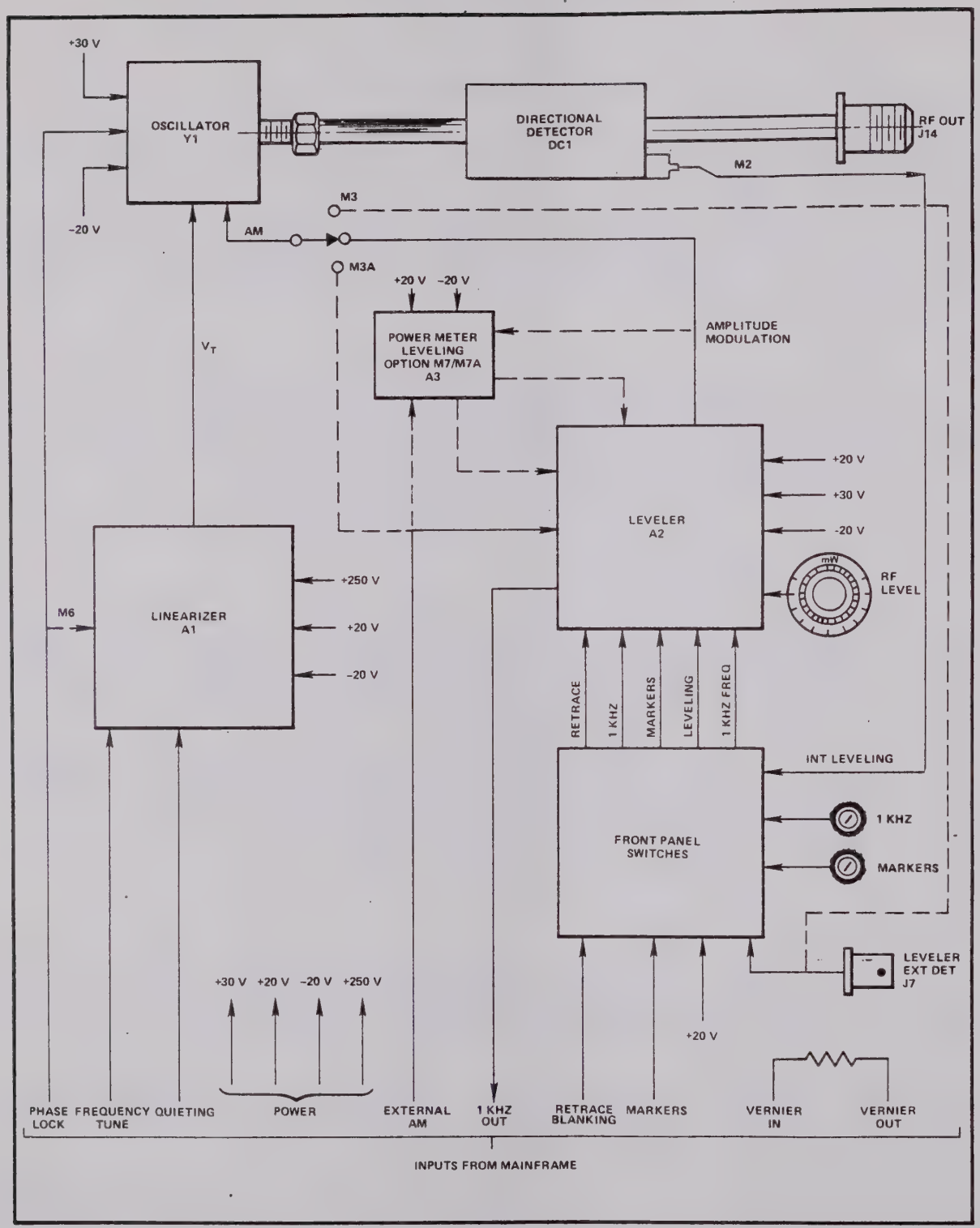


Figure 6-1. Model 5010 Block Diagram

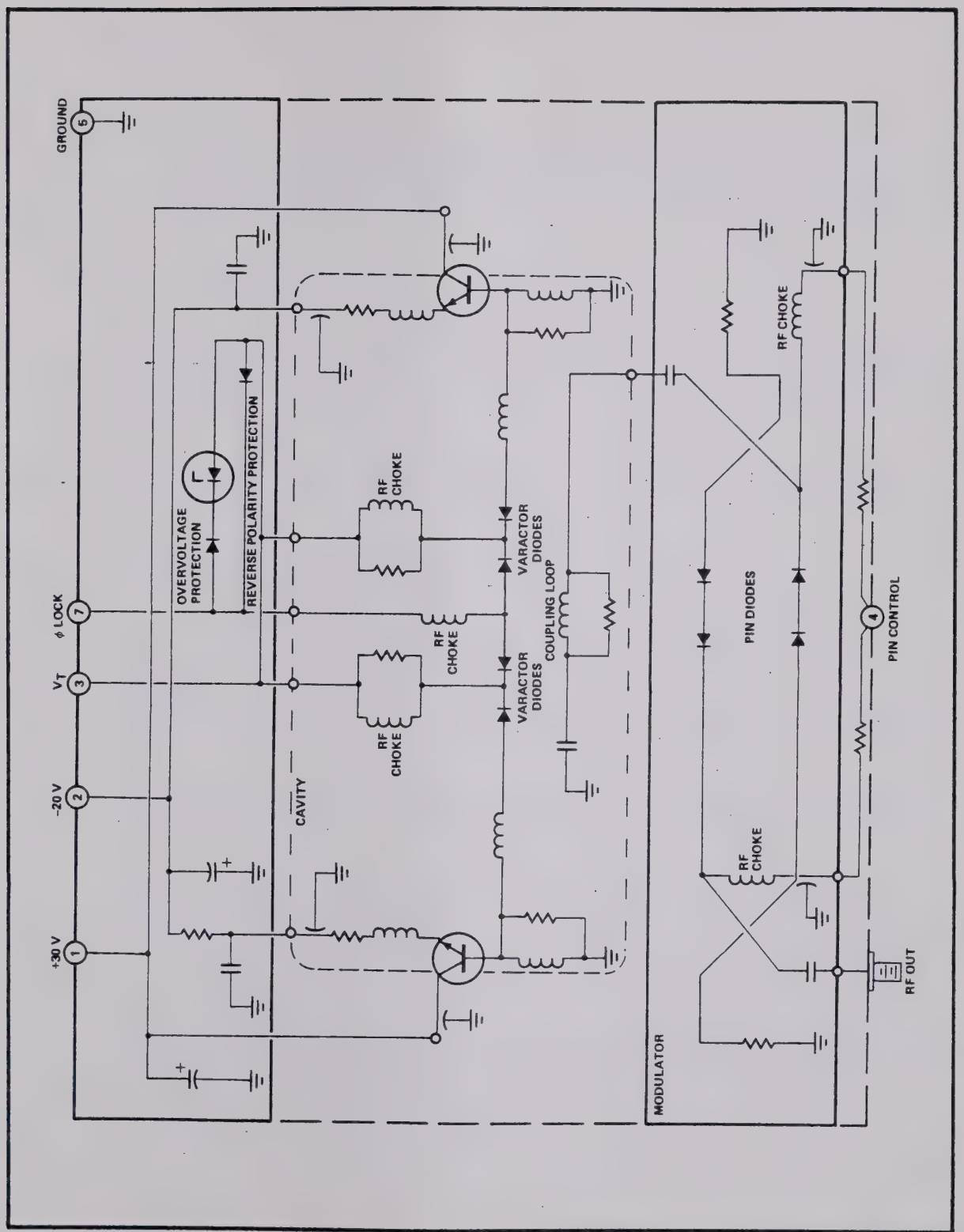


Figure 6-2. Simplified Schematic Diagram of LC Transistor Oscillator

SECTION VII

CHASSIS ASSEMBLY

7-1. REPLACEABLE PARTS LIST

Table 7-3 in this section contains a list of replaceable parts and subassemblies for Model 5010 RF Plug-in Unit including listings for Options M2, M3, M3A, M7, M7A, and M9. Replaceable parts lists for linearizer subassembly A1 are found in Section VIII. Replaceable parts lists for leveler subassembly A2, power meter leveling subassembly A3, and fast amplitude modulation subassembly A4 are found in Section IX.

7-1.1 Ordering Replacement Parts

The majority of the electronic parts used in the 5010 are standard distributor items, and should be available locally. To order special replacement parts and parts which are not otherwise obtainable, write to Systron-Donner Corporation at the address shown at the front of this manual, or contact your local Scientific Devices office.

Be sure to include the model number (5010M2, 5010M2/M7, etc.) and serial number of the unit for which parts are required. Please order by Systron-Donner part number; also include the reference designator where applicable.

7-1.2 Explanation of Table 7-3 Columns

7-1.2.1 FIG. NO./ITEM NO. This column references the figure numbers in which the part can be located and the parts location reference number in the parts breakdown drawing.

7-1.2.2 REF. DESIG. Electronic parts are listed in sequence by reference designation and may be located on the schematic diagram by this designator. Reference designators for components not available separately, which may be ordered only as part of another subassembly, are listed in *italic type.*

7-1.2.3 USE CODE. An entry in this column indicates that the part may not be found in all 5010's because it is part of an option, a part replaced when an option is ordered, or an alternate part. Table 7-1 lists the use codes for Model 5010.

7-1.2.4 SYSTRON-DONNER PART NUMBER. All standard parts manufactured by Systron-Donner or manufactured to Systron-Donner specifications are listed in this column, but not in the *MFR'S PART NUMBER* column. All other purchased parts which have been assigned Systron-Donner part numbers are also listed in this column. These part numbers must be used when ordering parts.

7-1.2.5 MFR'S PART NUMBER. Commercially-available parts not manufactured by Systron-Donner or to Systron-Donner specifications are listed in this column. Insofar as possible, these part numbers are complete. For best results, always include a complete part description as well as the listed manufacturer's part number when ordering replacement parts from manufacturers or distributors.

7-1.2.6 MFR. CODE. The five-digit Federal Manufacturers' Codes, as listed in Cataloging Handbooks H4-1 and H4-2, are listed in this column. These codes and corresponding manufacturers are listed in Table 7-2.

7-1.2.7 DESCRIPTION. Descriptions of component parts of subassemblies are indented to indicate the parts comprising each subassembly.

Table 7-1. Model 5010 Chassis Assembly Use Codes

CODE	EXPLANATION
B	Component which is part of a subassembly within the 5010; The size or electrical value of the component is determined by its use in the 5010, and is listed in the chassis parts list. No size or value is shown in the parts list for the subassembly, only the use code "B".
F	Component supplied to Systron-Donner Microwave Division specifications. *Manufacturer's standard part may not meet 5010 performance specifications unless screened by Microwave Division incoming inspection.*
G	Component supplied by manufacturer as part of purchased subassembly.
H	Modified part; physical alteration required from standard part as supplied by manufacturer before use in 5010.
M	Part supplied as part of Option M2, M3, M3A, M7, M7A, or M9
S	Standard version; part supplied in normally-supplied 5010 which may be replaceable by an "M" part if an option is ordered
T	Component size or electrical value is chosen by test as part of a calibration procedure

7-1.2.8 QTY. The quantity of the listed part used in a particular application is listed in this column. For example, if four screws are used to mount a subassembly, the number "4" is entered in this column, even if all four of the screws are not shown on the drawing. If two screws identical to these are used elsewhere in the chassis to mount another subassembly, the part will be listed again with the number "2" entered in the *QTY* column. If the same type of screw is to be used to mount an optional component, the screw will be listed a third time with "1" entered in the *QTY* column and the appropriate use coding letter in the *USE CODE* column.

7-1.3 Parts Breakdown

Figure 7-1 is the illustrated parts breakdown for all current versions of the 5010; the item numbers shown are used to locate the parts description in Table 7-3. The figure may also be used as a disassembly and reassembly guide.

7-2. SCHEMATIC DIAGRAMS

Figure 7-2 is the schematic/wiring diagram for Model 5010. Schematic diagrams for the individual subassemblies A1, A2, A3, and A4 are found in Sections VIII and IX.

Table 7-2. Manufacturers' Codes

CODE	NAME
01121	Allen Bradley Co., Milwaukee, WI 53204
01220	Systron-Donner Corporation, Microwave Division, Van Nuys, CA 91411
03306	Uniform Tubes, Inc., Collegeville, PA 19426
03494	General Electric Co., Schenectedy, NY 12305
06383	Panduit Corporation, Tinley Park, IL 60477
09353	C and K Components, Inc., Watertown, MA 02172
14674	Corning Glass Works, Bradford, PA 16701
15907	Micro-Mode Products, Inc., Santee, CA 92071
16179	Omni-Spectra, Inc., OSM Division, Merrimack, NH 03054
16733	Cablewave Systems, Inc., North Haven, CT 06473
26805	Omni-Spectra, Inc., Microwave Connector Division, Waltham, MA 02154
29111	Systron-Donner Corporation, Advanced Components Division, Sunnyvale, CA 94086
56289	Sprague Products, North Adams, MA 01247
72136	Electro-Motive Manufacturing Co., Inc., Willimantic, CT 06226
78189	Illinois Tool Works, Shakeproof Division, Elgin, IL 60120
79136	Waldes Kohinoor, Inc., Long Island City, NY 11101
83330	Herman H. Smith Co., Inc., Brooklyn, NY 11207
84841	Milford Rivet and Machine Co., New England Division, Milford, CT 06460
89709	Bunker Ramo Corporation, Connector Division, Broadview, IL 60153
94222	Southco, Inc., Lester, PA 19113
95146	Alco Electronic Products, Inc., Lawrence, MA 01842

Table 7-3. Model 5010 RF Plug-in Chassis Parts List

FIG. NO. / ITEM NO.	REF. DESIG.	USE CODE	SYSTRON-DONNER PART NUMBER	MFR. PART NO.	MFR. CODE	DESCRIPTION	QTY
7-1							
1	A1		950213		01220	BOARD ASSY — LINEARIZER (Uncalibrated)	1
2	A2		950279		01220	BOARD ASSY — LEVELER (Uncalibrated) Containing:	1
	A2C51	B	100173	DM15-101J	72136	CAPACITOR, Value Selected at Test; nominally CAPACITOR, Mica, 100 pF ±5%, 500 V	1
	A2R1	B	104846	RL07S242G	14674	RESISTOR, Metal Film, 2400 Ω ±2%, 1/4 W	1
	A2R75	B	104879	RL07S563G	14674	RESISTOR, Metal Film, 56 kΩ ±2%, 1/4 W	1
3	A3	M7	95060501		01220	BOARD ASSY — NEGATIVE POWER METER LEVELING	1
3	A3	M7A	95060502		01220	BOARD ASSY — POSITIVE POWER METER LEVELING	1
4	A4	M3/M3A	95023101		01220	BOARD ASSY — FAST A.M.	1
5	C101	M3/M3A	104147	192P1039R8	56289	CAPACITOR, Mylar, .01 μF ±10%, 80 V	1
6	C102	M3/M3A	104147	192P1039R8	56289	CAPACITOR, Mylar, .01 μF ±10%, 80 V	1
7	D13		105532	1N4446	03494	DIODE, Silicon, 75 PIV	1
8	DC1	M2,F	94857802	1001	29111	LEVELER ASSY Containing:	
	DC1R101	G				RESISTOR, Value Selected by Manufacturer	1
	J13	G	113143	679-001	16733	CONNECTOR, Flange-Mount, SMA male	1
	J14	G	113248	3004-7941	26805	CONNECTOR, Panel Mount, N female	1
9	J7		101155	UG-1094/U	89709	CONNECTOR, Receptacle, BNC	1
—	*J12*					*Part of Y1*	
—	*J13*					*Part of W1*	
—	*J13*	*M2*				*Part of DC1*	
—	*J14*					*Part of W1*	
—	*J14*	*M2*				*Part of W1*	
10	P20			26-159-24P	89709	CONNECTOR, Plug, 24-pin male	1
11	R1		104887	RL07S124G	14674	RESISTOR, Metal Film, 120 kΩ ±2%, 1/4 W	1
12	R2		107760	RL07S4753F	14674	RESISTOR, Metal Film, 475 kΩ ±1%, 1/4 W	1
13	R3		104861	RL07S103G	14674	RESISTOR, Metal Film, 10 kΩ ±2%, 1/4 W	1
14	R4		105500	WA1G0125103UA	01121	RESISTOR, Variable, 10 kΩ (MARKER ADJ)	1
15	R5		105499	WA1G0P103UA	01121	RESISTOR, Variable, 10 kΩ (RF LEVEL)	1
16	R6		105500	WA1G0125103UA	01121	RESISTOR, Variable, 10 kΩ (1 KHZ ADJ)	1
17	R8		104861	RL07S103G	14674	RESISTOR, Metal Film, 10 kΩ ±2%, 1/4 W	1
18	R17	T				RESISTOR, Value Selected at Test	1
19	R18	T				RESISTOR, Value Selected at Test	1
20	S9		105698	MTA-106D	95146	SWITCH, Toggle, SPDT (MARKERS)	1
21	S10		105698	MTA-106D	95146	SWITCH, Toggle, SPDT (RETRACE)	1
22	S11	S	105711	7301	09353	SWITCH, Toggle, 3PDT (LEVELER)	1
22	S11	M2	105715	7303E	09353	SWITCH, Toggle, 3PDT center-off (LEVELER)	1
23	S12		105698	MTA-106D	95146	SWITCH, Toggle, SPDT (1 KHZ)	1
24	S13	M3/M3A	105699	7201E	09353	SWITCH, Toggle, DPDT (FAST AM)	1
24	S19	M7/M7A	105698	MST-105D	95146	SWITCH, Toggle, SPDT (POWER METER)	1
25	W1	S,F	94860102	948190	29111	CABLE ASSY — RF Output Containing:	1
		G	107071	UT-141A	03306	CABLE, Coaxial, 50 Ω semi-rigid (0.141" dia.)	1
		G	107070	OSM201-1A	16179	CONNECTOR, Cable-Mount, SMA male	1
		G	113248	3004-7941	26805	CONNECTOR, Panel-Mount, N female	1
26	Y1	M2,F	94857801	SDVX-2011	29111	OSCILLATOR, Varactor-Tuned, 470—1030 MHz Containing:	1
	Y1A1	G				BOARD ASSY — OSCILLATOR INTERFACE	1
	Y1R101	G				RESISTOR, Value Selected by Manufacturer	1
	Y1R102	G				RESISTOR, Value Selected by Manufacturer	1
	J12	G				CONNECTOR, SMA Female	1
						Order as:	
		M2,F	948578		01220	KIT, RF, 5010M2 Containing: OSCILLATOR, Varactor-Tuned, 470—1030 MHz LEVELER ASSY	
		M2,F	94857801				
		M2,F	94857802				
						Order with:	
	A1	T	950213SP		01220	BOARD ASSY — MATCHED LINEARIZER	

Table 7-3. Model 5010 RF Plug-in Chassis Parts List (Continued)

FIG. NO. / ITEM NO.	REF. DESIG.	USE CODE	SYSTRON-DONNER PART NUMBER	MFR. PART NO.	MFR. CODE	DESCRIPTION	QTY
26	Y1	S,F	94860101	SDVX-2011	29111	OSCILLATOR, Varactor-Tuned, 470—1030 MHz	1
						Containing:	
	Y1A1	G				BOARD ASSY — OSCILLATOR INTERFACE	1
	Y1R101	G				RESISTOR, Value Selected by Manufacturer	1
	Y1R102	G				RESISTOR, Value Selected by Manufacturer	1
	J12	G				CONNECTOR, SMA Female	1
						Order as:	
		S,F	948601		01220	KIT, RF, 5010	
						Containing:	
		S,F	94860101			OSCILLATOR, Varactor-Tuned, 470—1030 MHz	
		S,F	94860102			CABLE ASSY — RF OUTPUT	
						Order with:	
	A1—	T	950213SP		01220	BOARD ASSY — MATCHED LINEARIZER	
27		H	105800	TM-1S4M	06383	ANCHOR, Strap, nylon no. 4	1
28		H	105797	TM-1S6M	06383	ANCHOR, Strap, nylon no. 6	4
29			928142		01220	BAR, Mounting, right	2
30			928243		01220	BAR, Mounting, left	2
31			104458	5133-12	79136	CLIP, E-Ring	2
32		M7/M7A	934188		01220	INSULATOR, Circuit Board	1
33		S	94000409		01220	KNOB ASSEMBLY, RF Level, 0 to 20 mW	1
33		M9	94000415		01220	KNOB ASSEMBLY, RF Level, 0 to +13 dBm	1
34			100509	1416-4	83330	LUG, Ground, internal tooth no. 4	1
35		M3/M3A	104465	1416-6	83330	LUG, Ground, internal tooth no. 6	1
36			104262	1497	83330	LUG, Ground, 3/8	1
37			104629	N-1A	95146	NUT, Knurled, 1/4-20	4
37		M3/M3A	104629	N-1A	95146	NUT, Knurled, 1/4-20	1
37		M7/M7A	104629	N-1A	95146	NUT, Knurled, 1/4-20	1
38			100941	511-041800-00	78189	NUT, Kep, 4-40	2
39				Supplied with S9-S12	95146	NUT, 1/4-20	4
39		M3/M3A		Supplied with S13	95146	NUT, 1/4-20	1
39		M7/M7A		Supplied with S19	95146	NUT, 1/4-20	1
40				Supplied with J7	89709	NUT, 3/8-32	1
41				Supplied with J14	26805	NUT, 5/8-24	1
42		S	915092		01220	PANEL ASSEMBLY, Front	1
						Order with:	
43			104515	58-26-54-24	94222	HOLDER, Captive Screw	1
44			96203811		01220	PLATE, Model	1
45			100617	50X7/64 NI BRS	84841	RIVET, Model Plate Mounting	2
42		M2	915044		01220	PANEL ASSEMBLY, Front	1
						Order with:	
43			104515	58-26-54-24	94222	HOLDER, Captive Screw	1
44			96203812		01220	PLATE, Model	1
45			100617	50X7/64 NI BRS	84841	RIVET, Model Plate Mounting	2
42		M3/M3A	91504301		01220	PANEL ASSEMBLY, Front	1
						Order with:	
43			104515	58-26-54-24	94222	HOLDER, Captive Screw	1
44			96203813		01220	PLATE, Model	1
45			100617	50X7/64 NI BRS	84841	RIVET, Model Plate Mounting	2
42		M7/M7A	91504302		01220	PANEL ASSEMBLY, Front	1
						Order with:	
43			104515	58-36-54-24	94222	HOLDER, Captive Screw	1
44			96203811		01220	PLATE, Model Number	1
45			100617	50X7/64 NI BRS	84841	RIVET, Model Plate Mounting	2
46			92201102		01220	PANEL, Rear	1
47			922016		01220	PLATE, Dial Scale Mounting	2
48			922120		01220	PLATE, Potentiometer/Connector Mounting	1
49			934003		01220	SCALE, Frequency Dial, 470—1030 MHz	1
50			104516	51-18-406-24	94222	SCREW, Knurled, captive	1
51			928018		01220	SCREW, Knurled, dial scale	2
52			104609		01220	SCREW, Fillister Head Phillips, 6-32 x 5/16	4
53			10072004	MS24693C2		SCREW, Flat Head Phillips, 4-40 x 1/4	2

Table 7-3. Model 5010 RF Plug-in Chassis Parts List (Continued)

FIG. NO. / ITEM NO.	REF. DESIG.	USE CODE	SYSTRON-DONNER PART NUMBER	MFR. PART NO.	MFR. CODE	DESCRIPTION	QTY
54			10073104	MS24693C24		SCREW, Flat Head Phillips, 6-32 x 1/4	4
55			10073105	MS24693C25		SCREW, Flat Head Phillips, 6-32 x 5/16	4
56			104601		01220	SCREW, Oval Head Phillips, 6-32 x 5/16	4
57			10062602	MS51957-11		SCREW, Pan Head Phillips, 4-40 x 1/8	1
58			10063203	MS51957-25		SCREW, Pan Head Phillips, 6-32 x 3/16	5
59			10063205	MS51957-27		SCREW, Pan Head Phillips, 6-32 x 5/16	2
60			10063205	MS51957-27		SCREW, Pan Head Phillips, 6-32 x 5/16	1
61		S	10063205	MS51957-27		SCREW, Pan Head Phillips, 6-32 x 5/16	1
62		M3/M3A	10063205	MS51957-27		SCREW, Pan Head Phillips, 6-32 x 5/16	2
63		M7/M7A	10063205	MS51957-27		SCREW, Pan Head Phillips, 6-32 x 5/16	1
64		M7/M7A	10063214	MS51957-33		SCREW, Pan Head Phillips, 6-32 x 7/8	2
65		M7/M7A	104563	8583	83330	SPACER, Hexagonal, no. 6 x 1/2	2
66			100753	SST-1	06383	STRAP, Nylon	10
67			104463	2160	83330	WASHER, Flat Fiber, no. 6	8
68		M3/M3A	104463	2160	83330	WASHER, Flat Fiber, no. 6	2
69		M7/M7A	104463	2160	83330	WASHER, Flat Fiber, no. 6	2
70				Supplied with J7	89709	WASHER, Lock, 3/8	1
71				Supplied with J14	15907	WASHER, Lock, 5/8	1
72		M3/M3A	100712	MS35338-136		WASHER, Split Lock, no. 6	2
73		M7/M7A	100712	MS35338-136		WASHER, Split Lock, no. 6	2
74				Supplied with S9—S12	95146	WASHER, Switch Locating	4
74		M3/M3A		Supplied with S13	95146	WASHER, Switch Locating	4
74		M7/M7A		Supplied with S19	95146	WASHER, Switch Locating	1

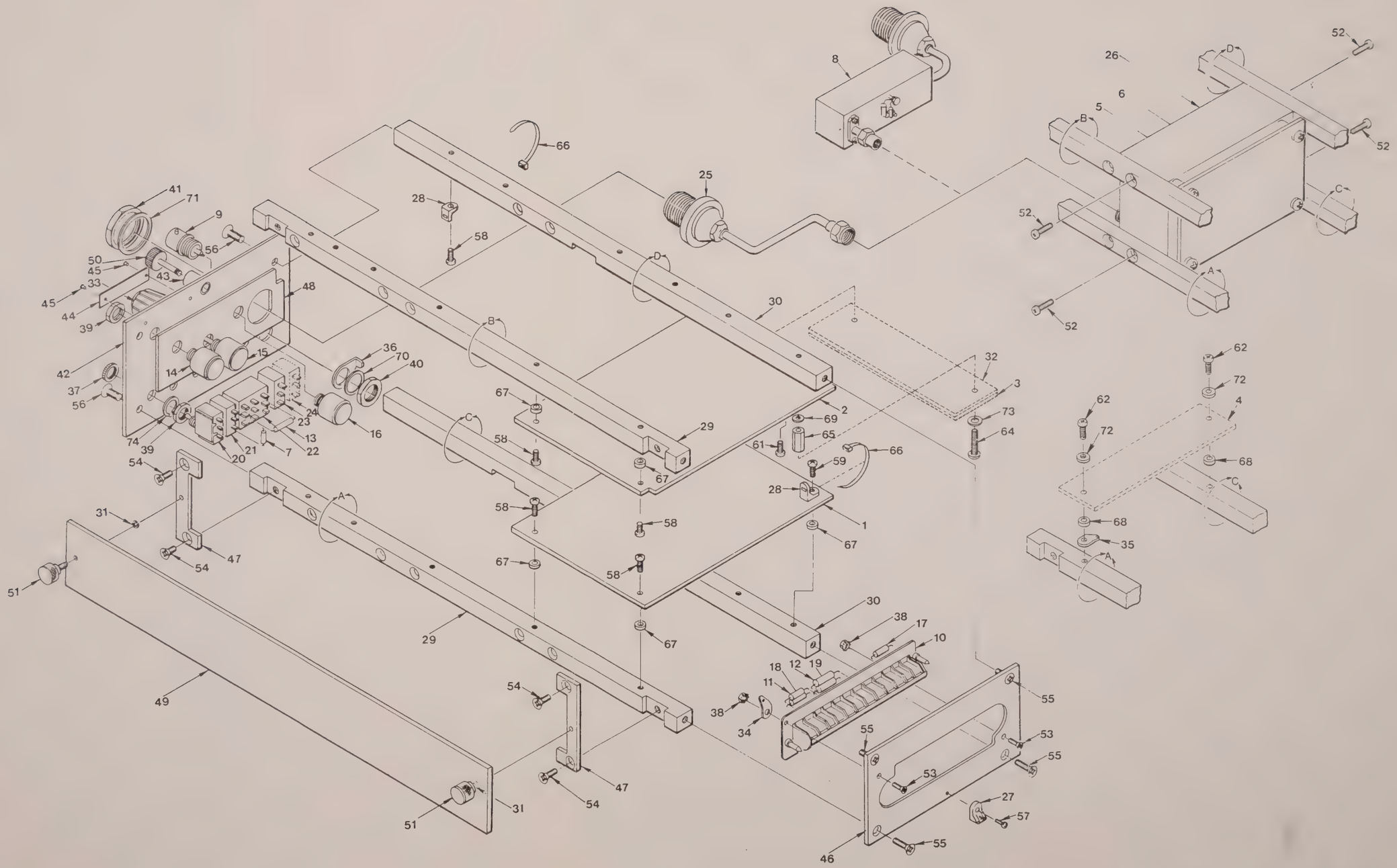


Figure 7-1. Model 5010 RF Plug-in Illustrated Parts Breakdown

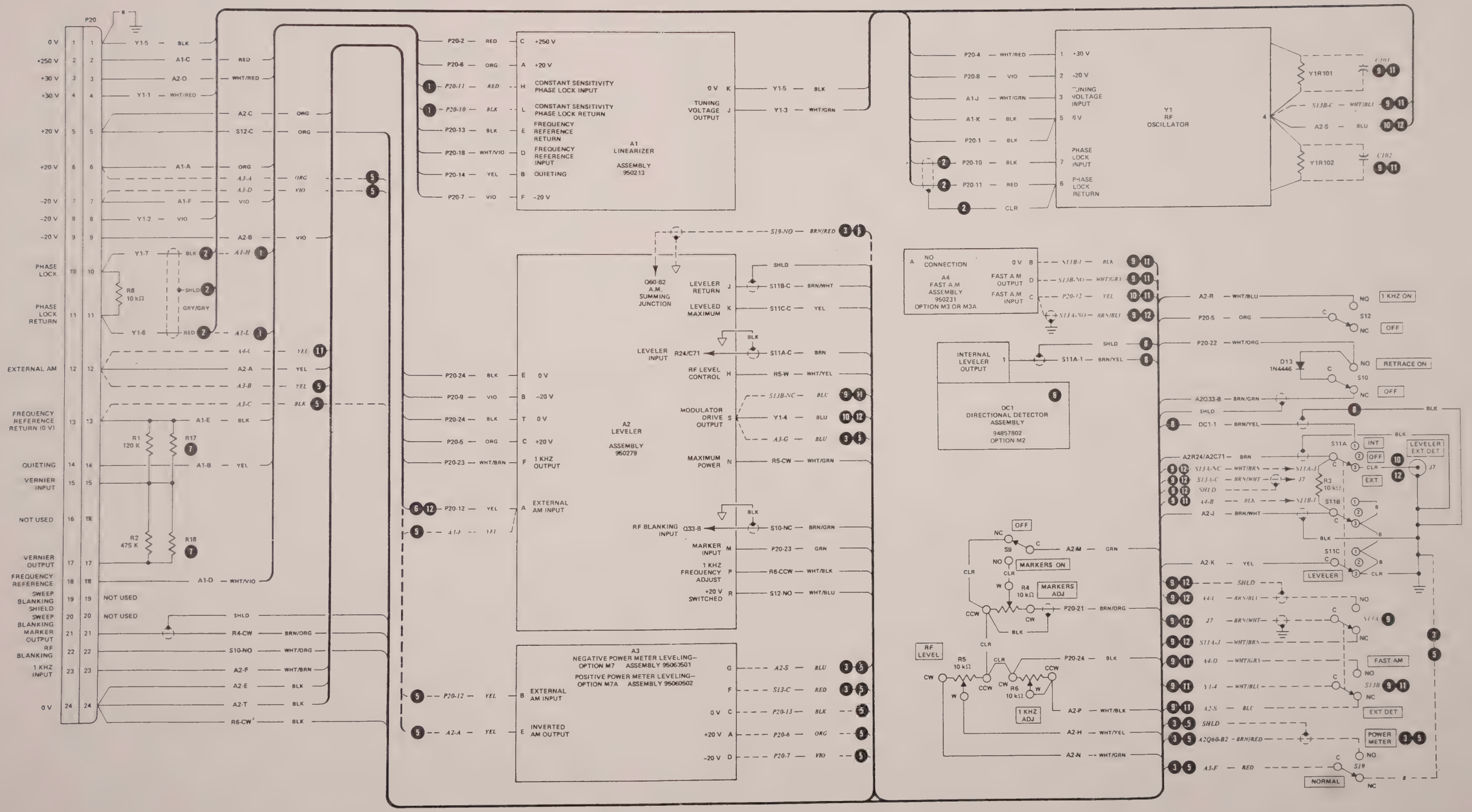


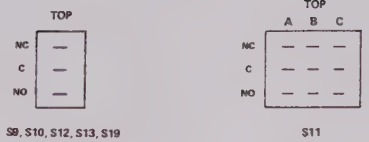
Figure 7-2. Model 5010 RF Plug-in Schematic/Wiring Diagram

WIRE COLOR LEGEND		
ABBREVIATION	WIRE NUMBER	WIRE TYPE WIRE COLOR
BLK	0	BLACK
BRN	1	BROWN
RED	2	RED
ORG	3	ORANGE
YEL	4	YELLOW
GRN	5	GREEN
BLU	6	BLUE
VIO	7	VIOLET
GRY	8	GREY
WHT	9	WHITE
B		BARE BUS WIRE
CLR	99	BARE BUS WIRE/ CLEAR SLEEVING
WHT/BLK	90	WHITE/BLACK STRIPE
WHT/BRN	91	WHITE/BROWN STRIPE
WHT/RED	92	WHITE/RED STRIPE
WHT/ORG	93	WHITE/ORANGE STRIPE
WHT/YEL	94	WHITE/YELLOW STRIPE
WHT/GRN	95	WHITE/GREEN STRIPE
WHT/BLU	96	WHITE/BLUE STRIPE
WHT/VIO	97	WHITE/VIOLET STRIPE
WHT/GRY	98	WHITE/GREY STRIPE
BRN/BRN	110	BROWN COAXIAL CABLE
BRN/RED	120	BROWN COAXIAL CABLE/RED STRIPE
BRN/ORG	130	BROWN COAXIAL CABLE/ORANGE STRIPE
BRN/YEL	140	BROWN COAXIAL CABLE/YELLOW STRIPE
BRN/GRN	150	BROWN COAXIAL CABLE/GREEN STRIPE
BRN/BLU	160	BROWN COAXIAL CABLE/BLUE STRIPE
BRN/VIO	170	BROWN COAXIAL CABLE/VIOLET STRIPE
BRN/GRY	180	BROWN COAXIAL CABLE/GREY STRIPE
BRN/WHT	190	BROWN COAXIAL CABLE/WHITE STRIPE
GRY/GRY	88	GREY SHIELDED CABLE

NOTES:

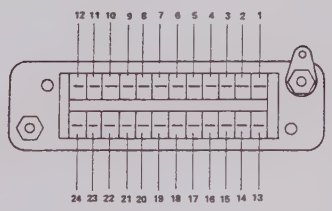
1. ADD FOR OPTION M6
2. DELETE FOR OPTION M6
3. ADD FOR OPTION M7
4. DELETE FOR OPTION M7
5. ADD FOR OPTION M7A
6. DELETE FOR OPTION M7A
7. COMPONENT VALUE SELECTED AT TEST
8. ADD FOR OPTION M2
9. ADD FOR OPTION M3
10. DELETE FOR OPTION M3
11. ADD FOR OPTION M3A
12. DELETE FOR OPTION M3A

REAR VIEW



S9, S10, S12, S13, S19 — S11

REAR VIEW

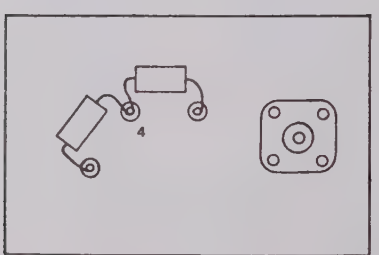


P20

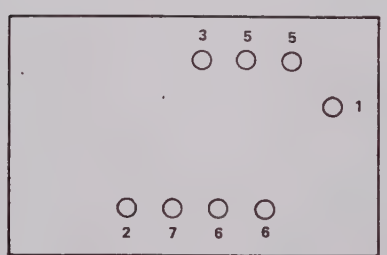
REAR VIEW

R4, R5, R6

ALL DIODES



Y1 (FRONT VIEW)



Y1 (REAR VIEW)

SECTION VIII

LINEARIZER

8-1. GENERAL

This section contains circuit theory, trouble isolation information, a replaceable parts list, and a schematic diagram with parts location information for Linearizer Printed Circuit Board Assembly A1. Overall plug-in and radio-frequency component operating theory for the RF plug-in in which A1 is installed may be found in Section VI, with the plug-in chassis interconnect wiring diagram and parts list in Section VII.

8-2. THEORY OF OPERATION

8-2.1 Operating Principles

8-2.1.1 TUNING VOLTAGES (FIGURE 8-1). The varactor-tuned oscillator used in the plug-in unit has a tuning curve which is essentially exponential; the tuning voltage required to tune the oscillator over its full frequency range varies slightly from module to module. The three families of oscillators used in the RF plug-ins have tuning voltages of zero to plus 50 volts, zero to plus 60 volts, or minus 700 millivolts to plus 65 volts. The tuning voltage from the mainframe is a linear ramp (or a discrete voltage in CW and Manual Scan modes) of zero to minus 10 volts. The voltage shaping procedure by which the linear tuning input from the mainframe is made to approximately the tuning characteristic of the oscillator module is known as *linearizing.*

The linearizer assembly is factory-calibrated for a particular oscillator module so that the output frequency changes by a constant increment for each incremental change of tuning voltage input.

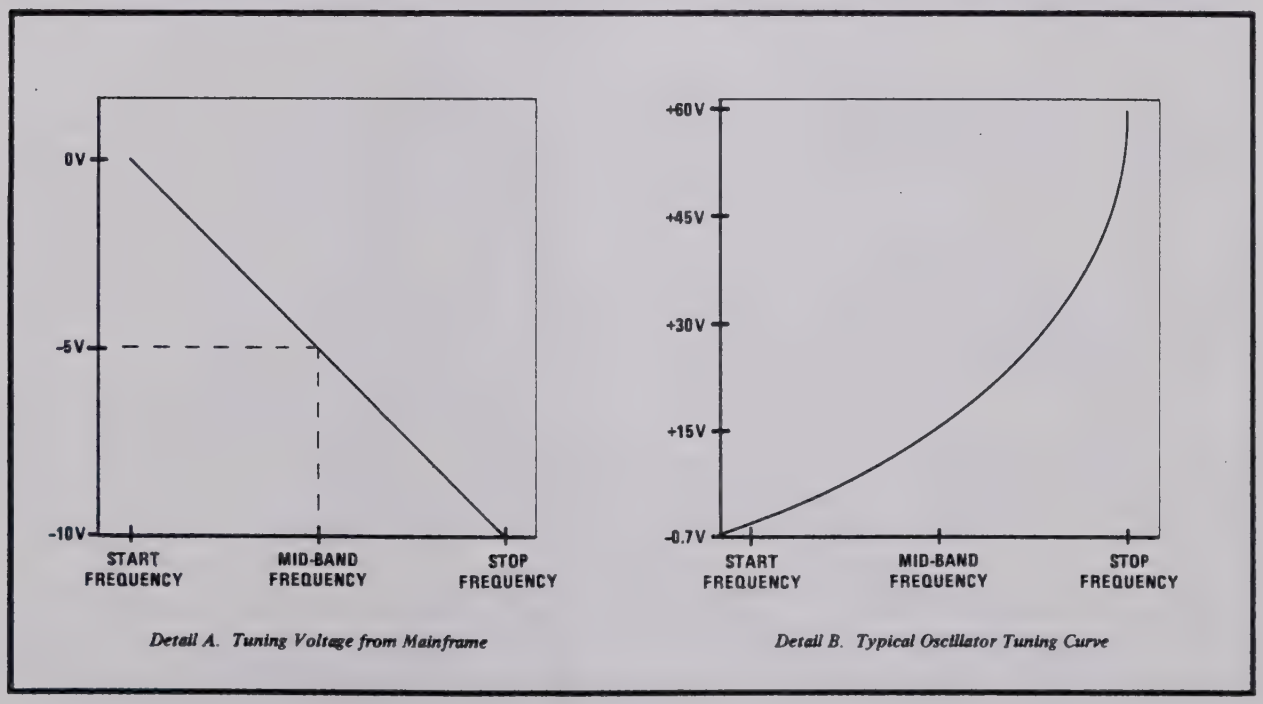


Figure 8-1. Frequency Tuning Voltages

8-2.1.2 AMPLIFIER GAIN CONTROL (FIGURE 8-2). The voltage shaping process is accomplished by controlling the gain of an operational amplifier as the frequency reference input from the mainframe is varied. The gain of an infinite-impedance operational amplifier is determined by the ratio of the value of its feedback resistor to the value of its input resistor. In the theoretical operational amplifier circuit of Figure 8-2, the voltage gain is determined by the ratio of the feedback resistor (R_{fb}) to the input resistor (R_{in}). Initially, when switches S1 and S2 are open, the value of input resistance (R_{in}) is equal to the resistance of R1. If switch S1 is closed, R_{in} is the parallel combination of R1 and R2. Reducing the input resistance causes the gain of the operational amplifier to increase. Closing switch S2 will add resistor R3 to the parallel combination of R1 and R2, reducing the total input resistance and increasing the gain of the amplifier.

When S1 and S2 are made voltage-dependent switches, the amplitude of the input voltage at any particular moment will determine the gain of the amplifier. Figure 8-3 shows the input-output transfer characteristic of the linear amplifier with voltage-controlled gain.

8-2.2 Circuit Theory (Figure 8-5)

8-2.2.1 INPUT AMPLIFIERS. The zero to minus 10 volt frequency reference output of the mainframe is differentially coupled to operational amplifier A1Q94 of the linearizer; this device is connected as an inverting current summer operating with a voltage gain of minus one. The differential connection assures that any common mode noise — unwanted signals appearing on the frequency reference input and on the return — is cancelled. This considerably reduces the effect of line-frequency and other extraneous conducted or radiated emissions upon the output frequency of the driven oscillator.

The inverted output of A1Q94 is fed to the negative voltage shaper circuits through resistor A1R24 and to summer/inverter A1Q95 through resistor A1R34; A1Q95 re-inverts the input ramp (or discrete CW or manual scan tuning voltage) to its original input polarity and couples this output to the positive voltage shaper through resistor A1R1.

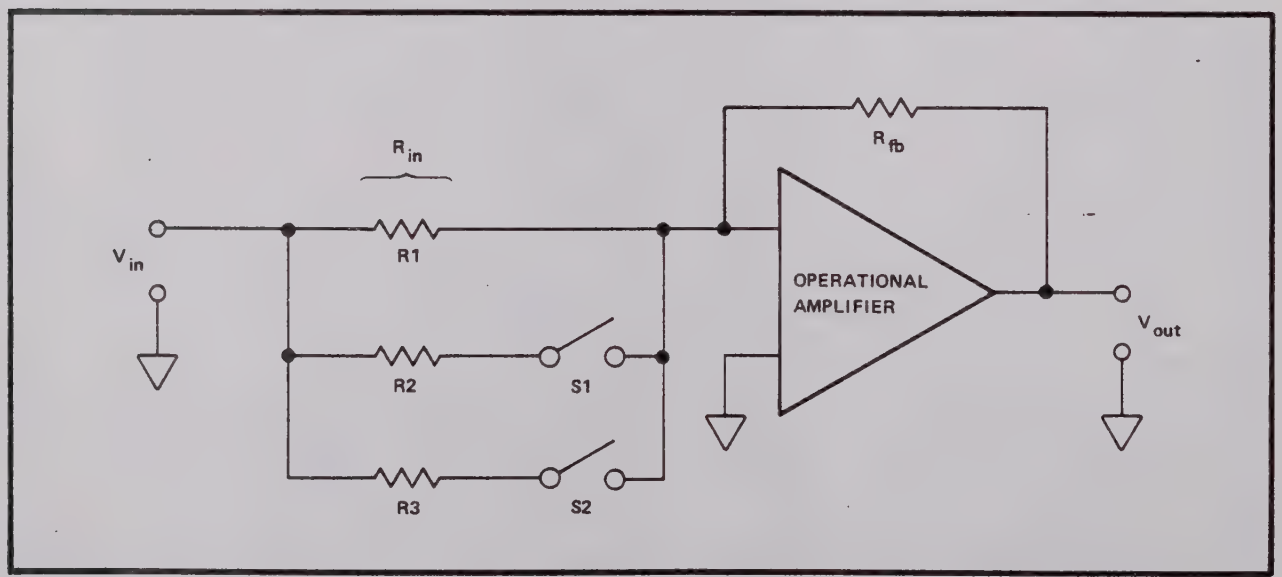


Figure 8-2. Theoretical Operational Amplifier

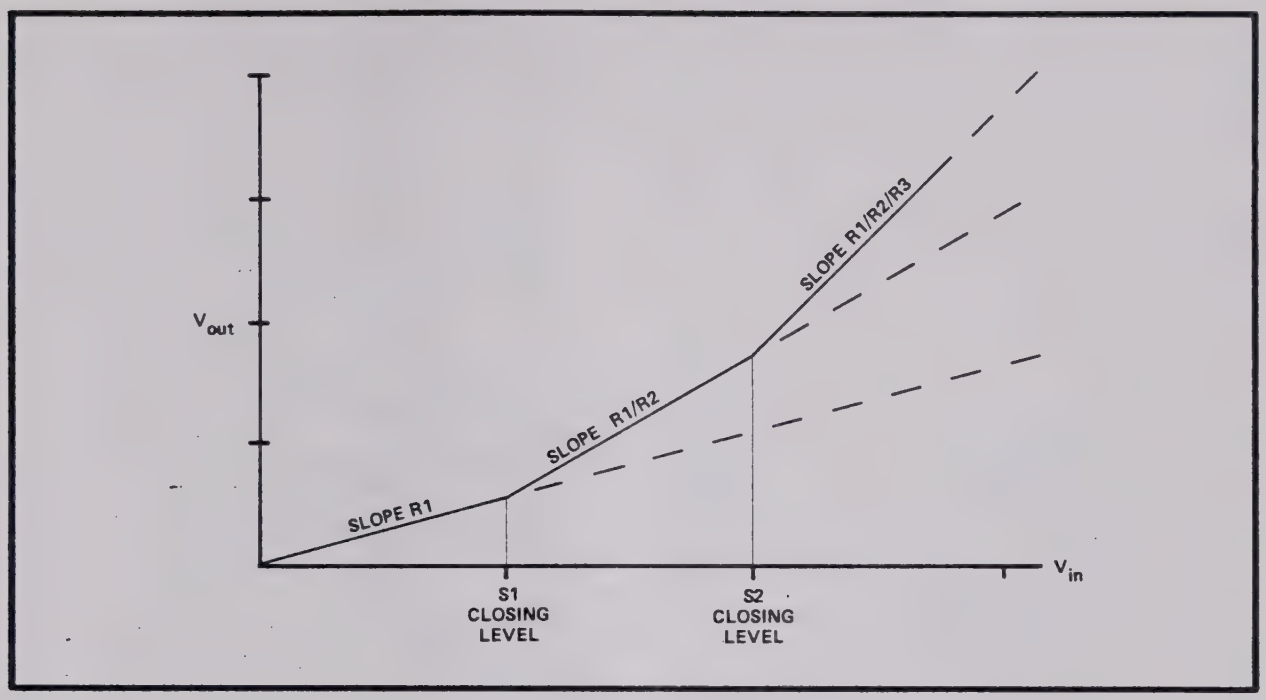


Figure 8-3. Transfer Characteristics of Theoretical Operational Amplifier

8-2.2.2 **POSITIVE VOLTAGE SHAPER.** Diodes A1D101 through A1D112 (mounted in a heat-equalizing housing on the linearizer board) and resistors A1R1 through A1R23 comprise the positive voltage shaper. The diodes serve the function of the voltage-dependent switches described in Paragraph 8-2.1.2. The diodes are closed switches when they are forward biased and open switches when they are reverse biased.

At the beginning of a typical sweep, the input voltage of the ramp from the mainframe is zero; the output voltages of inverters A1Q94 and A1Q95 are also zero. Current flows from the plus 20 volt supply through steering diode A1D101 and the resistor string containing A1R1 through A1R12. This creates a positive voltage on the nodes between the resistors in the string (points B, C, ... L), causing diodes A1D102, A1D103 . . . . A1D112 to be reverse biased.

As the sweep voltage from the mainframe becomes increasingly negative, the first diodes begin to become forward biased. At a frequency reference input voltage of approximately minus 600 millivolts, the voltage at point A (Figure 8-4) will also be about minus 600 millivolts; the voltage at point B will be about zero. At this point, diode A1D112 becomes forward biased, connecting resistor A1R13 in parallel with input resistor A1R77/A1R78. Reducing the input resistance in this manner causes the gain of the operational amplifier circuit comprising A1Q96, A1Q97, and A1Q98 to increase.

As the input frequency reference voltage continues to increase in amplitude (to a maximum of minus 10 volts), each succeeding diode in turn is forward biased to connect another parallel resistor across A1R77/A1R78. The transfer characteristics of the linearizer are shown in Figure 8-4.

In practice, it is rarely necessary to use all the diodes in the positive voltage shaper to linearize a particular oscillator; most A1 boards will be missing at least one of the *series* resistors (A1R1 through A1R12) and at least one of the *shunt* resistors (A1R13 through A1R23). The series and shunt resistors are selected during the factory linearizing procedure to shape the tuning output curve at A1-J to match the tuning curve of the oscillator used in the RF plug-in.

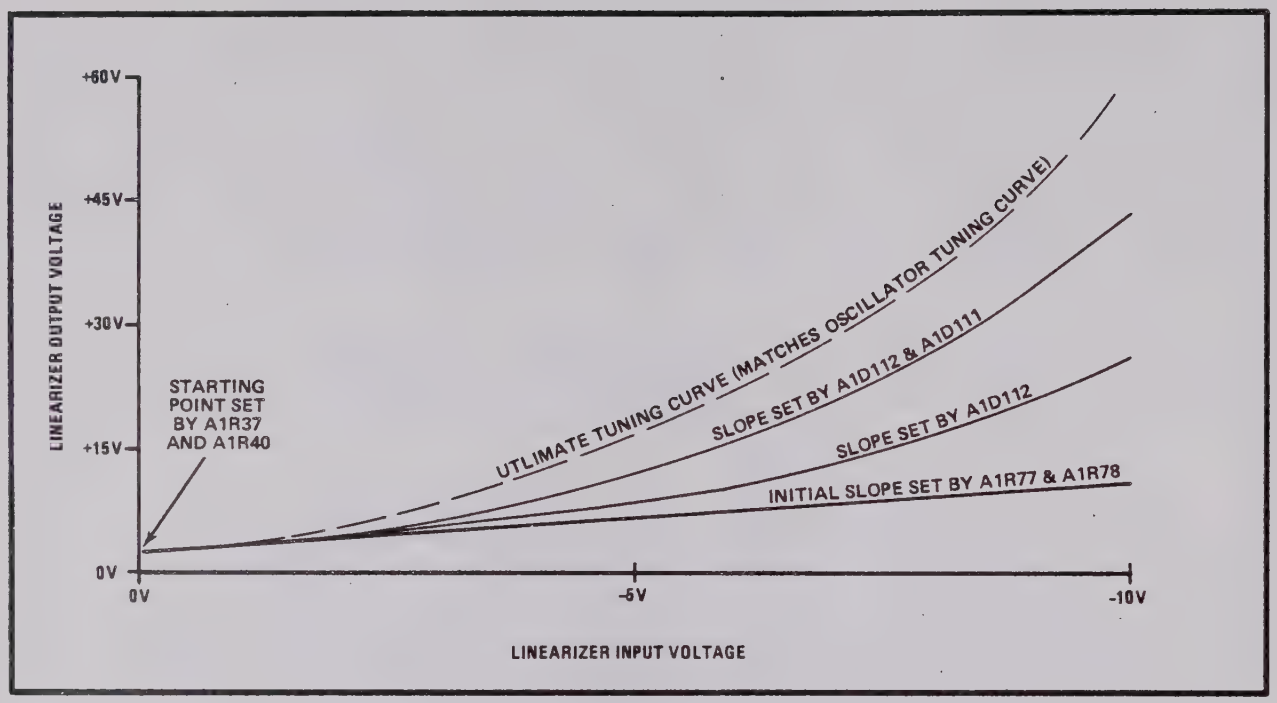


Figure 8-4. Transfer Characteristics of Linearizer

8-2.2.3 **NEGATIVE VOLTAGE SHAPER.** In some instances, turning on one of the diodes in the positive voltage shaper may cause the gain of the output amplifier (A1Q96/A1Q97/A1Q98) to be excessive at a particular frequency reference voltage input. The negative voltage shaper operates in the same manner as the positive voltage shaper, but it reduces the gain of the linearizer board to allow close matching of the output tuning voltage to the tuning curve of the oscillator.

8-2.2.4 **OUTPUT AMPLIFIER.** Integrated circuit operational amplifier A1Q96, transistor A1Q98, and transistor A1Q97 form a high-voltage operational amplifier with adjustable offset and variable gain. Offset resistors A1R37 and A1R40 are selected during the linearization process to set the calibrated low-frequency limit of the oscillator. Gain resistors A1R77/A1R78 and feedback resistors A1R41/A1R42 are selected during linearization to set the calibrated high-frequency limit of the oscillator.

8-2.2.5 **OSCILLATOR PROTECTION.** Zener diode A1D88 prevents the output of the linearizer board from exceeding plus 68 volts, an amplitude below the damage level of the oscillator module. The varactor-tuned oscillator module itself is fitted with overvoltage and reverse-polarity protection diodes.

8-2.2.6 **QUIETING.** When the sweeper mainframe is operated in a non-swept mode — CW or manual scan — a quieting input of about plus five volts activates quieting switches A1Q99/A1Q100 to connect capacitor A1C76 across the output amplifier. This capacitive feedback reduces the bandwidth of the output amplifier to less than 10 hertz, reducing incidental tuning noise and residual FM in the RF output.

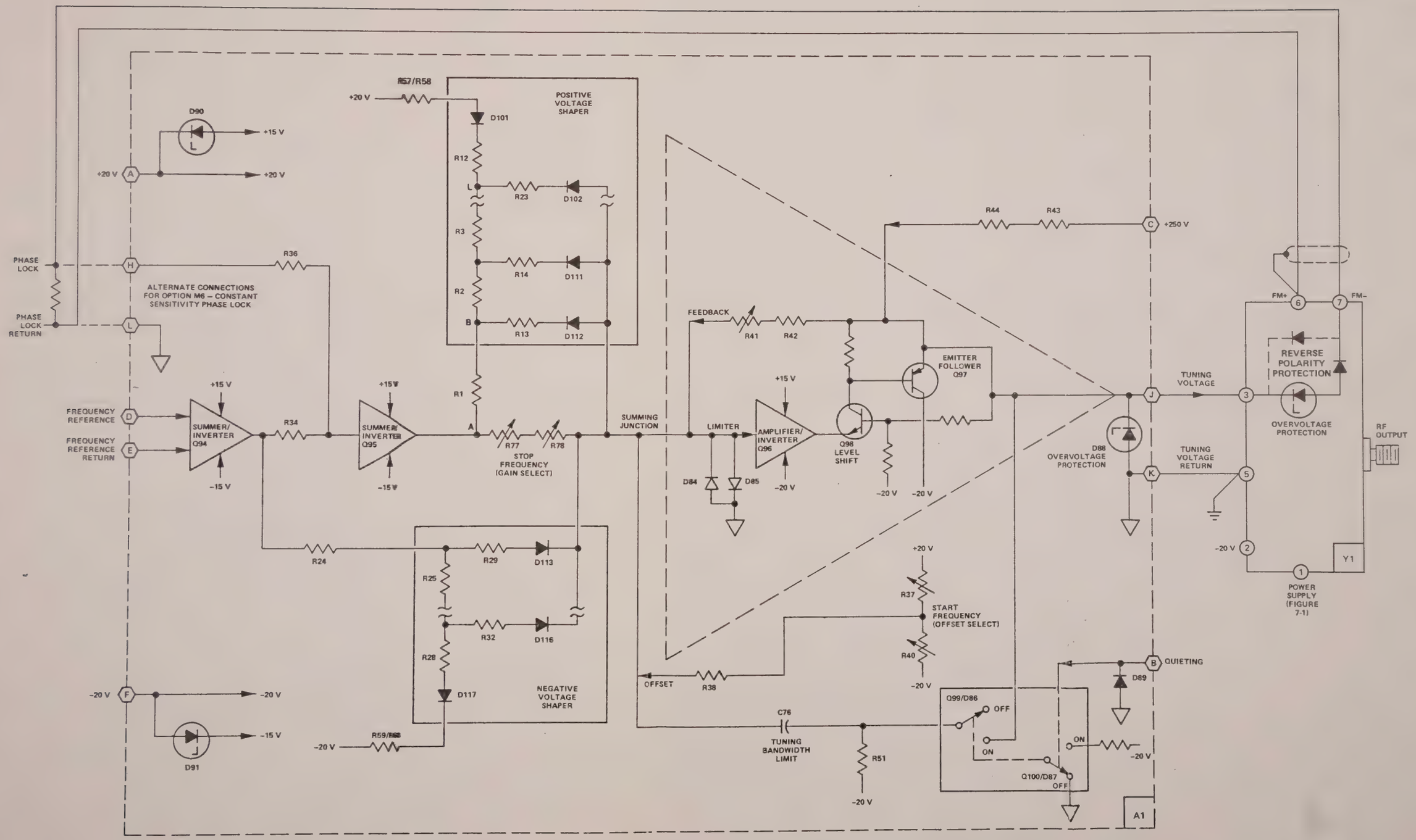


Figure 8-5. Linearizer Simplified Schematic Diagram

8-3. TROUBLE ISOLATION

If a malfunction in Linearizer board A1 is indicated, the gains of the operational amplifier stages should be checked to isolate the malfunctioning stage. The following information will aid the trouble isolation process:

1. The plug-in voltage chart, Table 5-1 of Section V.

2. The circuit descriptions and simplified schematic diagram in Paragraph 8-2 of this section.

3. Schematic diagram and parts location drawing Figure 8-6 at the end of this section; this drawing includes basing diagrams of the multi-lead semiconductor devices used on A1.

IMPORTANT

If extensive trouble isolation work is anticipated, the white/green wire from A1-J should be disconnected from oscillator terminal 3 and connected through a 20 kΩ resistor to chassis ground.

CAUTION

BE CAREFUL WITH TEST EQUIPMENT PROBES. ACCIDENTAL CONNECTION OF THE +250 VOLT POWER SUPPLY TO THE OSCILLATOR MODULE WILL CAUSE MAJOR DAMAGE TO THE MODULE.

WARNING

WORK WITH EXTREME CAUTION AROUND THE PLUG-IN IN GENERAL AND THE LINEARIZER BOARD IN PARTICULAR. THE +250 VOLT POWER SUPPLY IS POTENTIALLY LETHAL.

8-4. REPLACEABLE PARTS LIST

Table 8-2 in this section contains a list of replaceable parts for Linearizer Assembly A1. Replaceable parts lists for the chassis assembly are found in Section VII. Replaceable parts lists for leveler subassembly A2 and for optional printed circuit assemblies are found in Section IX.

8-4.1 Ordering Replacement Parts

The majority of the electronic parts used in construction of the A1 board assembly are standard distributor items, and should be available locally. To order special replacement parts and parts which are not otherwise obtainable, write to Systron-Donner Corporation at the address shown on page i of this manual, or contact your local Scientific Devices office.

Be sure to include the model number and serial number of the unit for which parts are required. Please order by Systron-Donner part number; also include the A1 reference designator where applicable.

8-4.2 Explanation of Columns

8-4.2.1 FIG NO. This column references the figure number of the drawings in which the part can be located.

8-4.2.2 REF. DESIG. Electronic parts are listed in sequence by reference designation and may be located on the schematic diagram by this designator.

8-4.2.3 USE CODE. An entry in this column indicates that the part may not be found in all units because it is part of an option, a part replaced when an option is ordered, or an alternate part. The component size or electrical value of a component coded "T" is chosen by test as part of a calibration procedure.

8-4.2.4 SYSTRON-DONNER PART NUMBER. All standard parts manufactured by Systron-Donner or manufactured to Systron-Donner specifications are listed in this column, but not in the *MFR'S PART NUMBER* column. All other purchased parts which have been assigned Systron-Donner part numbers are also listed in this column. These part numbers must be used when ordering parts.

8-4.2.5 MFR'S PART NUMBER. Commercially-available parts not manufactured by Systron-Donner or to Systron-Donner specifications are listed in this column. Insofar as possible, these part numbers are complete. For best results, always include a complete part description as well as the listed manufacturer's part number when ordering replacement parts from manufacturers or distributors.

8-4.2.6 MFR. CODE. The five-digit Federal Manufacturers Codes, as listed in Cataloging Handbooks H4-1 and H4-2, are listed in this column. These codes and corresponding manufacturers are listed in Table 8-1.

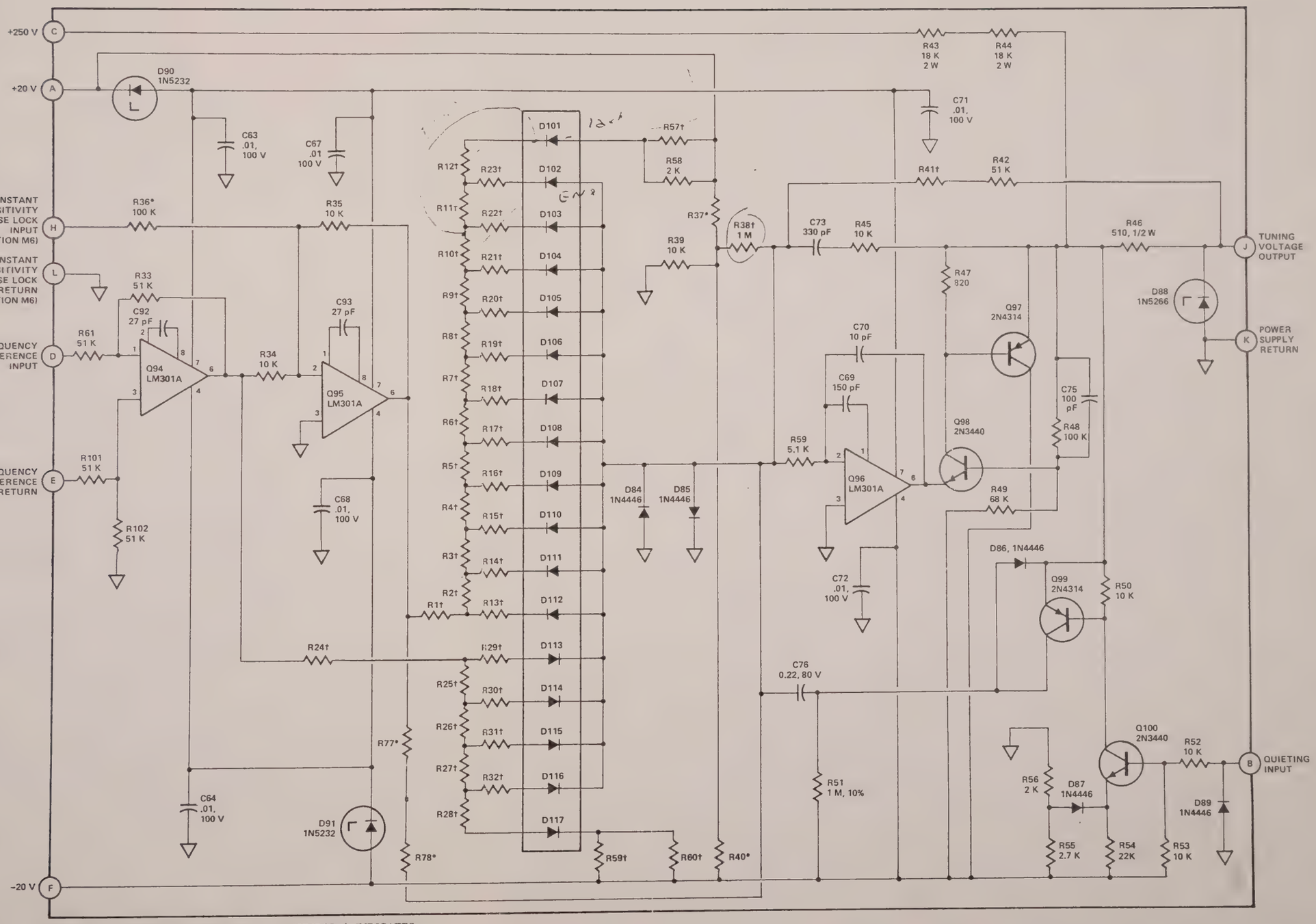
8-4.2.7 DESCRIPTION. Descriptions of component parts of subassemblies are indented to indicate the parts comprising each subassembly.

8-5. SCHEMATIC DIAGRAMS

Figure 8-6 is the A1 board parts location drawing and schematic diagram. Schematic diagrams for the A2 board and all optional boards are found in Section IX; the chassis wiring diagram is in Section VI.

Table 8-1. Manufacturers' Codes

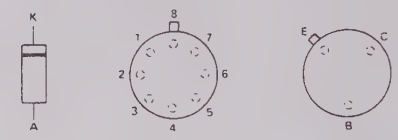
CODE	NAME
01121	Allen Bradley Co., Milwaukee, WI 53204
01220	Systron-Donner Corporation, Microwave Division, Van Nuys, CA 91411
01295	National Semiconductor Corp., Santa Clara, CA 95051
02735	RCA Solid State Division, Somerville, NJ 08876
03494	General Electric Co., Schenectedy, NY 12305
04713	Motorola, Inc., Semiconductor Products Division, Phoenix, AZ 85036
14674	Corning Glass Works, Bradford, PA 16701
56289	Sprague Electric Co., North Adams, MA 01247
71002	Birnbach Co., Inc., Freeport, NY 11520
72136	Electro-Motive Manufacturing Co., Inc., Willimantic, CT 06226
91418	Radio Materials Division of P.R. Mallory, Chicago, IL 60646



NOTES: 1. SYMBOL * INDICATES COMPONENT VALUE SELECTED AT TEST
2. SYMBOL † INDICATES COMPONENT VALUE SELECTED AT FACTORY

Figure 8-6. Linearizer Printed Circuit Board Assembly A1 Parts Location/Schematic Diagram

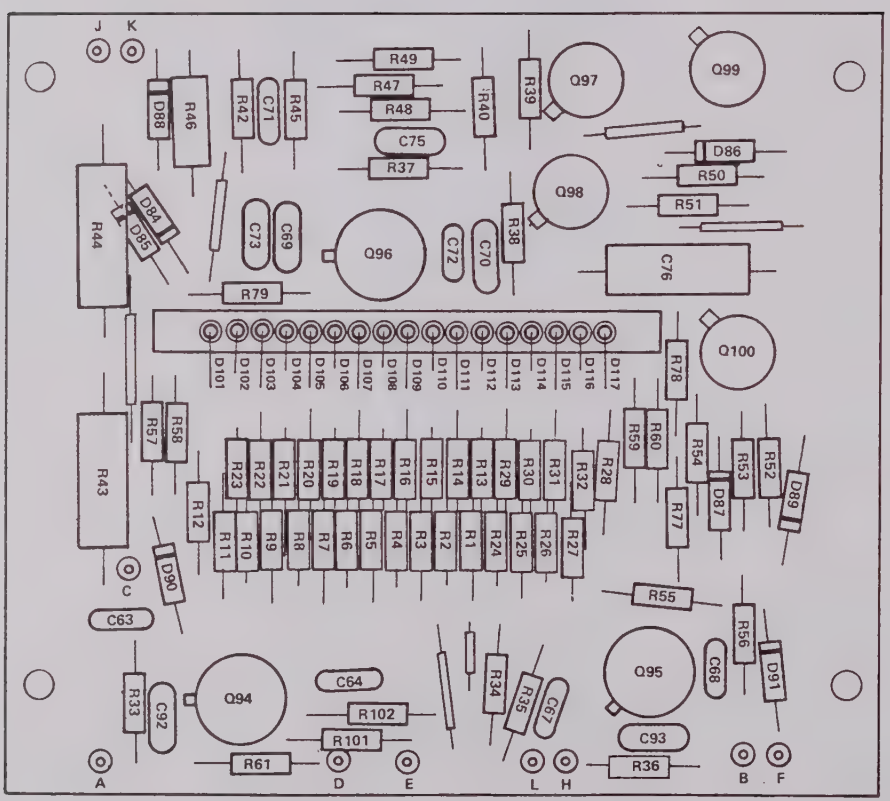
VIEWS FROM TOP OF SEMICONDUCTOR DEVICE



ALL DIODES

Q94, Q95, Q96

Q97, Q98, Q99, Q100



SECTION IX

LEVELER

9-1. GENERAL

This section contains circuit theory, trouble isolation information, a replaceable parts list, and a schematic diagram with parts location and test point information for Leveler Printed Circuit Board Assembly A2, Power Meter Leveling Printed Circuit Board Assembly A3, and Fast A.M. Printed Circuit Board Assembly A4. Overall plug-in and radio-frequency component operating theory for the RF plug-in in which the leveler board assembly is installed may be found in Section VI, with the plug-in chassis interconnect wiring diagram and parts list in Section VII.

9-2. THEORY OF OPERATION (Figure 9-1)

The output amplitude of the RF plug-in is controlled by a PIN diode modulator inside oscillator module Y1; the general operating principles of this device were described in Section VI. Drive for the PIN diodes is provided by A2.

The Leveler circuits integrate several inputs into drive for the modulator:

1. Output power control from front-panel **RF LEVEL** potentiometer R5.
2. 1-kHz square-wave modulation from the generator on A2.
3. External amplitude modulation signals coupled through the mainframe.
4. Sweep retrace blanking from the mainframe
5. Leveling feedback from the directional detector in the plug-in (Option M2)
6. Leveling feedback from an external crystal detector.
7. Leveling feedback from an RF power meter (Options M7 and M7A)

The output drive to the modulator diodes is determined by the total current from all input sources flowing into the summing junction of an operational amplifier comprising A2Q60, A2Q62/A2Q63, and A2Q64.

9-2.1 Modulator Drive Levels

RF energy in the cavity of oscillator module Y1 is passed through a PIN diode modulator mounted to the front of the oscillator; the modulator diodes require negative-polarity drive if they are to conduct (refer to Figure 6-2). A drive level of zero from A2-S to Y1-4 will result in an output signal which is nearly fully attenuated; a slightly positive output reverse-biases both PIN diodes and results in full attenuation. An output of approximately minus five volts turns the PIN diodes on completely, allowing maximum RF output.

9-2.2 Operating Modes

Three operating modes are available from the leveling circuits: internal leveling (units with Option M2), leveling off, and external leveling. A (generally undesired) fourth mode can occur if the leveling feedback loop is broken, usually by a cable defect or operator selection of the external leveling mode when no external leveling devices are connected (or selection of internal leveling in units without

Option M2). In this mode, there is no control of the output amplitude; it will be either fully on or fully off.

Units equipped with Option M3 or Option M3A cannot be operated in a leveled mode and a fast AM mode simultaneously.

Units equipped with Option M7 or Option M7A are leveled with the "recorder" output of a microwave power meter through the amplifier circuits of A2.

9-2.2.1 LEVELING OFF MODE. The simplest amplitude control configuration exists when the **LEVELER** switch is set to **OFF**. The amplitude control circuits are in an open loop configuration in leveling off mode; if there are no marker, blanking, or external AM inputs, and if the **1 KHZ** switch is set to **OFF**, then the only inputs to the summing junction of the operational amplifier come from **RF LEVEL** control R5 through A2-H and A2R55, and from A2-J through R3 and A2R24.

Feedback current flows from the modulator drive output at A2-S through A2R75, R3, and A2R24 to provide a negative bias. Offset current flows from the plus 20 volt supply through A2R2 and **RF LEVEL** control R5. A current determined by the potentiometer setting is fed to the summing junction of the operational amplifier through A2R55.

9-2.2.2 FAULT MODE. It was previously mentioned that an undefined leveling mode could occur if the **LEVELER** switch was set to **EXT** and no negative feedback input was connected (or to **INT** in units without Option M2). An examination of this mode demonstrates the action of the modulator driver circuits.

Setting switch S11 to **EXT** short circuits the off-level offset voltage from terminal A2-J directly to ground. With only a positive input from R5 through A2-H and A2R55 connected to the summing junction, the operational amplifier acts less as a current integrator than as a comparator. When the voltage at the inverting summing junction exceeds that at the non-inverting summing junction, the output changes state. The positive input causes a stiff negative output to drive the base of transistor A2Q97. This turns off the NPN transistor. Modulator drive comes from the minus 20 volt supply through A2Q64 and A2R72.

The negative voltage input drives the PIN modulator diodes in Y1 to maximum conductance (minimum attenuation), allowing the maximum available oscillator output to be coupled to the **RF OUT** connector. Negative voltage at this junction also turns on switch A2CR95 and places a feedback capacitor (A2C51) across the operational amplifier to eliminate spurious oscillation.

The negative output amplitude is limited to minus 6.2 volts by diode A2D41 and Zener diode A2D39 in series across the operational amplifier. In addition to the modulator protection afforded by the excursion limiter — which holds the maximum output to plus 1.2 or minus 6.2 volts — voltage limiter diodes A2D28 and A2D29 prevent the summing junction voltage from exceeding plus or minus 600 millivolts.

9-2.2.3 EXTERNAL LEVELING MODE. If a negative leveling feedback signal is connected to J7, it will be coupled through the closed contacts of switch S11A and through terminal A2R24 to the summing junction. Resistor R3 serves as a load for the input signal in external leveling mode.

In leveled mode, switch section S11C completes a path to ground for resistors A2R1 and A2R67, which then become part of a voltage divider with A2R2. This reduces the maximum voltage available at R5 to a lower value than in unleveled mode.

The inputs to the summing junction of the operational amplifier now consist of negative feedback through S11A and positive **RF LEVEL** control from R5. The negative input will tend to reduce the negative output of A2Q97, reducing the RF amplitude, while the positive input from R5 will tend to increase the output of A2Q97 and increase the output amplitude. The ultimate drive level to the PIN diodes is a combination of the feedback from the external detector and the **RF LEVEL** control setting.

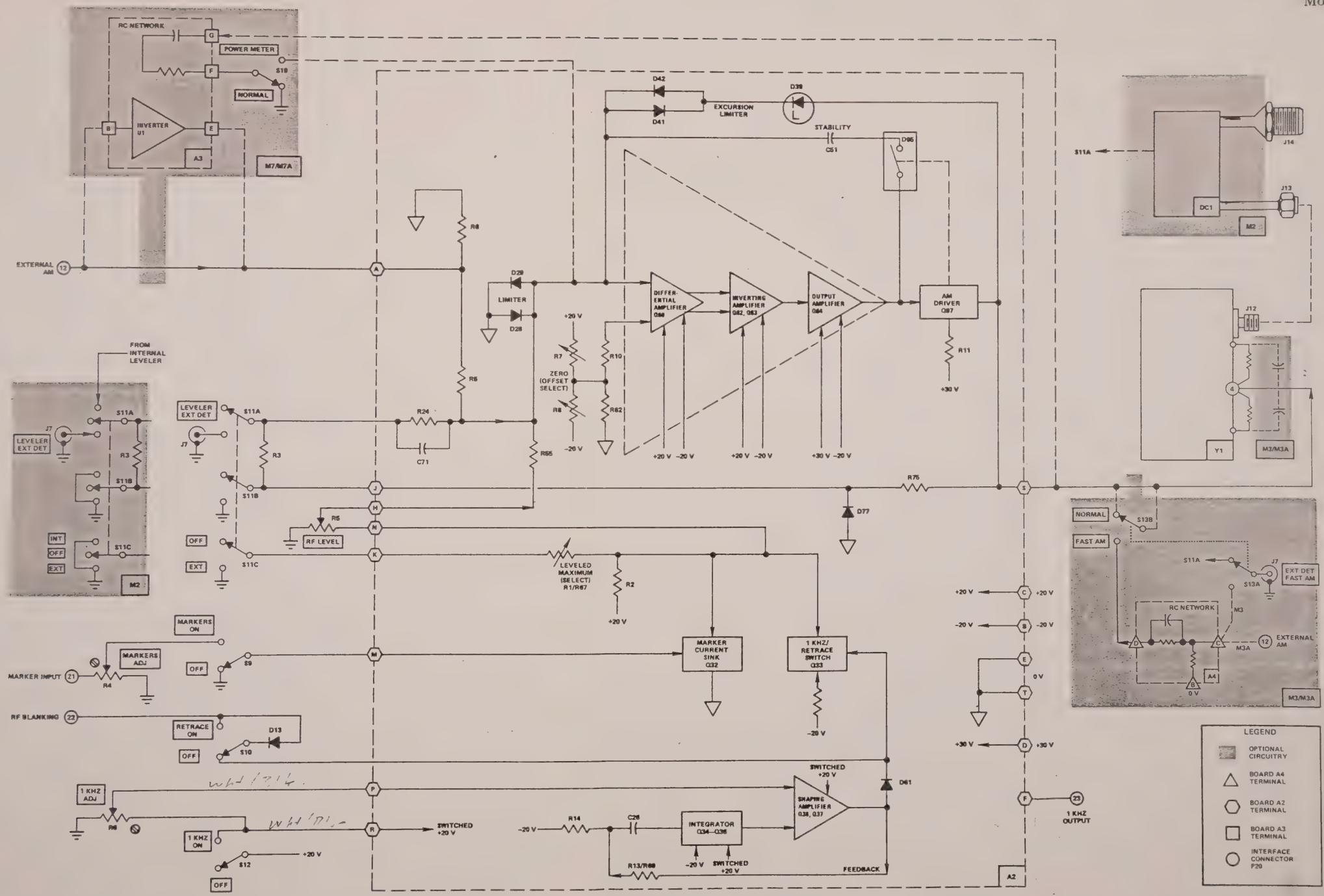


Figure 9-1. Leveler Simplified Schematic Diagram

9-2.2.4 **INTERNAL LEVELING MODE.** Operation in units equipped with Option M2 is identical to that described for external leveling, except that negative feedback is coupled from directional detector DC1 through switch S11A.

9-2.2.5 **MARKERS.** When the **MARKERS** switch is set to **ON**, a marker pulse from the mainframe is coupled through switch S9 and A2-M to current sink A2Q32, reducing the current available to R5. This causes a brief reduction of the current from R5 (through A2-H and A2R55) into the summing junction and reduces the RF output amplitude at marker points. The amount of reduction is determined by the marker pulse amplitude as set by **MARKERS ADJ** control R4.

9-2.2.6 **BLANKING.** A plus five volt sweep retrace (flyback) blanking pulse is coupled through diode D13 and switch S10 when the **RETRACE** switch is set to **OFF**. During the retrace period, switch A2Q33 is turned on, causing the voltage at A2-N to become negative; the resulting current flow through R5, A2-H, and A2R55 causes the summing junction to become negative, the output to become positive, and the output of A2Q97 to become positive enough to drive the PIN diodes in Y1 to maximum attenuation.

The blanking input is coupled through D13 to isolate it from the 1 kilohertz square wave which is also coupled to the base of A2Q33 through A2D61 (refer to Paragraph 9-2.2.8).

9-2.2.7 **EXTERNAL AM.** External AM inputs are connected through A2-A and voltage divider A2R5/A2R6 to the summing junction. As with any input to the summing junction, a negative input will reduce RF output amplitude and a positive input will increase it.

9-2.2.8 **1 KHZ GENERATOR.** Transistors A2Q34, A2Q35, and A2Q36 comprise an operational amplifier connected as a Miller integrator. As capacitor A2C26 charges through resistors A2R13 and A2R69, the output of the integrator is a positive-going linear ramp. When the ramp reaches a predetermined amplitude, A2C26 discharges through A2R14 and downward integration begins.

Shaping amplifier A2Q38/A2Q37 comprises two triggered switches which convert the triangular waveform into a square wave output. The exact frequency of the generator is controlled by the voltage from R6 through A2-P to the shaping amplifier which determines the level to which A2C26 must change before downward integration begins.

9-2.2.9 **OPTION M3.** External amplitude-control signals may be coupled to the PIN diode modulator in oscillator module Y1 without processing by leveling board A2. In RF plug-ins equipped with Fast A.M. Option M3, external inputs are coupled through the front-panel **EXT DET/FAST AM** connector, switch S13A, and the R-C network on printed circuit assembly A4, and switch S13B to the modulator input at Y1-4. The leveling, one kilohertz, retrace blanking, and marker functions from Leveler board A2 are not available in *fast AM* mode.

9-2.2.10 **OPTION M3A.** Operation in Option M3A *fast AM* mode is similar to that described in Paragraph 9-2.2.9, but the amplitude-control input signal is coupled through the *external AM* connector of the mainframe, pin 12 of the interface connector, and switch S13B to the PIN diode modulator.

9-2.2.11 **OPTION M7.** RF plug-ins equipped with Option M7 power meter leveling are equipped with an R-C network to reduce the frequency response of the amplifier formed by A2Q60/A2Q62/A2Q63/A2Q64 and A2Q97. The components which comprise the network are mounted on printed circuit assembly A3. The network is switched into the circuit by **POWER METER/NORMAL** switch S19.

9-2.2.12 **OPTION M7A.** In addition to the R-C network described in Paragraph 9-2.2.11, printed circuit assembly A3 in RF plug-ins with Option M7A include an operational amplifier configured as a unity-gain inverter. Amplifier A3U1 inverts the external AM input from a positive-output power meter and offsets it to act as an amplitude-control signal to the external AM input at A2-A.

9-3. TROUBLE ISOLATION

If a malfunction in Leveler board A2 is indicated, the following information should be used to aid the trouble isolation process:

1. The plug-in voltage chart, Table 5-1 of Section V.

2. The circuit descriptions and simplified schematic diagram in Paragraph 9-2 of this section.

3. Schematic diagram and parts location drawings Figures 9-2, 9-3, and 9-4 at the end of this section; these drawings include basing diagrams of the multi-lead semiconductor devices used on A2 and A3.

WARNING

WORK WITH EXTREME CAUTION AROUND THE PLUG-IN. THE +250 VOLT POWER SUPPLY IS POTENTIALLY LETHAL.

8-4. REPLACEABLE PARTS LIST

Table 9-2 in this section contains a list of replaceable parts for Leveler Assembly A2. Tables 9-3 and 9-4 list replaceable parts for Power Meter Leveling Assembly A3; Table 9-4 lists replaceable parts for Fast A.M. board A4. Replaceable parts lists for the chassis assembly are found in Section VII. A replaceable parts list for Linearizer Subassembly A1 is found in Section VIII.

8-4.1 Ordering Replacement Parts

The majority of the electronic parts used in construction of the A2, A3, and A4 board assemblies are standard distributor items, and should be available locally. To order special replacement parts and parts which are not otherwise obtainable, write to Systron-Donner Corporation at the address shown at the front of this manual, or contact your local Scientific Devices office.

Be sure to include the model number and serial number of the unit for which parts are required. Please order by Systron-Donner part number; also include the A2, A3, or A4 reference designator where applicable.

9-4.2 Explanation of Columns

9-4.2.1 FIG. NO. This column references the figure number of the drawings in which the part can be located.

9-4.2.2 REF. DESIG. Electronic parts are listed in sequence by reference designation and may be located on the schematic diagram by this designator.

9-4.2.3 USE CODE. An entry in this column indicates that the part may not be found in all units because it is part of an option, a part replaced when an option is ordered, or an alternate part. The size or electrical value of a component coded "B" is determined by its use in the RF plug-in, and is listed in the chassis part list. No size or value is shown on the parts list for A2 (refer to Table 7-3, Section VII). The component size or electrical value of a component coded "T" is chosen by test as part of a calibration procedure.

9-4.2.4 **SYSTRON-DONNER PART NUMBER.** All standard parts manufactured by Systron-Donner or manufactured to Systron-Donner specifications are listed in this column, but not in the *MFR'S PART NUMBER* column. All other purchased parts which have been assigned Systron-Donner part numbers are also listed in this column. These part numbers must be used when ordering parts.

9-4.2.5 **MFR'S PART NUMBER.** Commercially-available parts not manufactured by Systron-Donner or to Systron-Donner specifications are listed in this column. Insofar as possible, these part numbers are complete. For best results, always include a complete part description as well as the listed manufacturer's part number when ordering replacement parts from manufacturers or distributors.

9-4.2.6 **MFR. CODE.** The five-digit Federal Manufacturers Codes, as listed in Cataloging Handbooks H4-1 and H4-2, are listed in this column. These codes and corresponding manufacturers are listed in Table 9-1.

9-4.2.7 **DESCRIPTION.** Descriptions of component parts of subassemblies are indented to indicate the parts comprising each subassembly.

9-5. SCHEMATIC DIAGRAMS

Figure 9-2 is the A2 board parts location drawing and schematic diagram. Figure 9-3 contains the schematic diagrams and parts location drawings for both versions of the A3 board. Figure 9-4 is the schematic diagram and parts location drawing for the A4 board. The schematic diagram for the A1 board is found in Section VIII; the chassis wiring diagram is in Section VII.

Table 9-1. Manufacturers' Codes

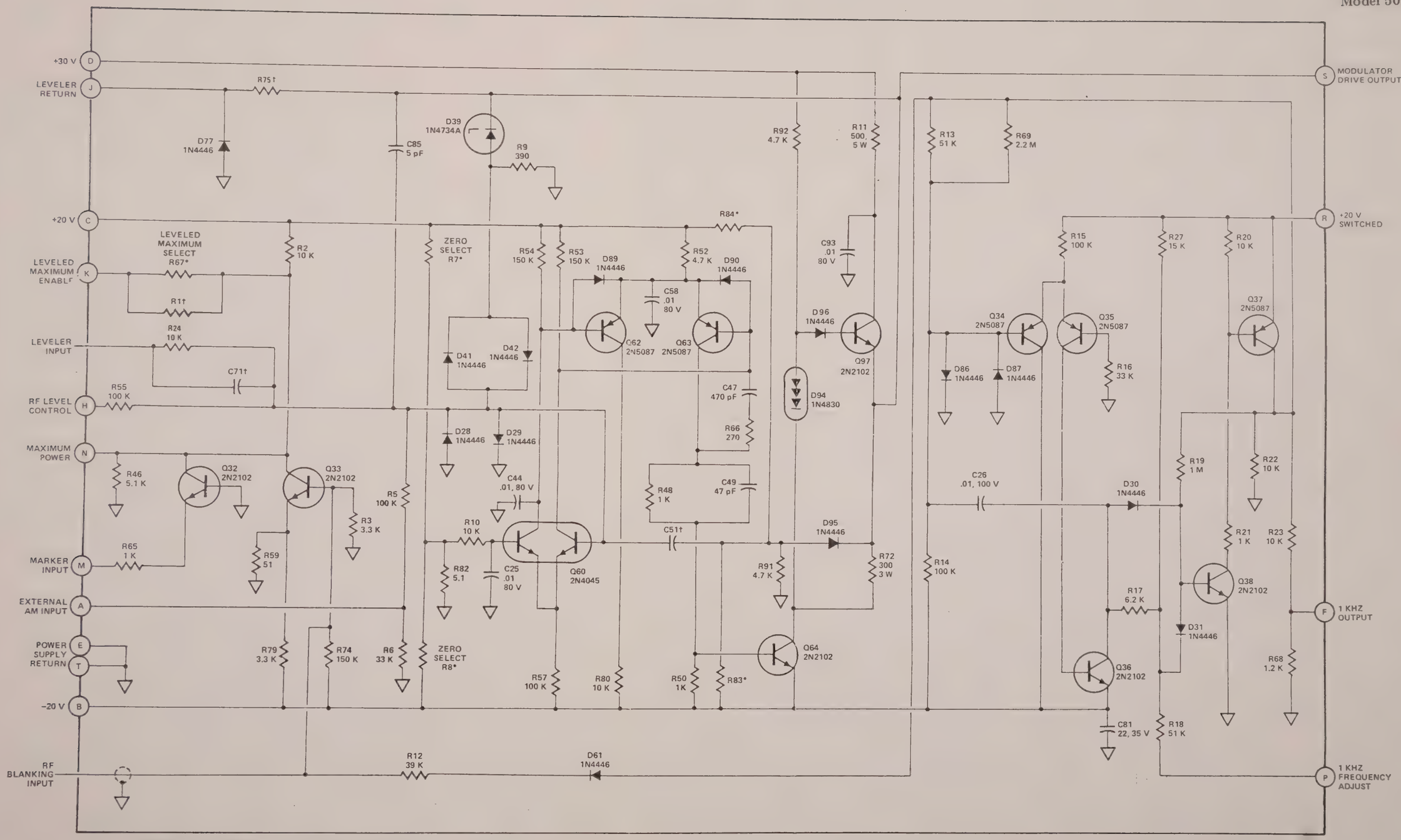
CODE	NAME
00656	AVX Ceramics, Division of AVX Corporation, Myrtle Beach, SC 29577
01121	Allen Bradley Co., Milwaukee, WI 53204
01220	Systron-Donner Corporation, Microwave Division, Van Nuys, CA 91411
03494	General Electric Co., Schenectedy, NY 12305
04713	Motorola, Inc., Semiconductor Products Division, Phoenix, AZ 85036
14674	Corning Glass Works, Bradford, PA 16701
18714	RCA Solid State Products Division, Findley, OH 45840
22229	Union Carbide Corporation, Mountain View, CA 94040
56289	Sprague Products Co., North Adams, MA 01247
63743	Ward Leonard Electric Co., Mount Vernon, NY 10550
71002	Birnbach Co., Inc., Freeport, NY 11520
72136	Electro-Motive Manufacturing Co., Inc, Willamantic, CT 06226
91418	Radio Materials Co., Division of P.R. Mallory, Chicago, IL 60646
98978	International Electronic Research Corp., Burbank, CA 91502

Table 9-2. Leveler Printed Circuit Board Assembly A2 Parts List

FIG. NO. / ITEM NO.	REF. DESIG.	USE CODE	SYSTRON-DONNER PART NUMBER	MFR. PART NO.	MFR. CODE	DESCRIPTION
	A2		950279		01220	BOARD ASSY – LEVELER Containing:
	A2C25		104147	192P1039R8	56289	CAPACITOR, Mylar, .01 μF ±10%, 80 V
	A2C26		104152	1MD-1-103J	72136	CAPACITOR, Mylar, .01 μF ±5%, 100 V
	A2C44		104147	192P1039R8	56289	CAPACITOR, Mylar, .01 μF ±10%, 80 V
	A2C47		100221	DM15-471J	72136	CAPACITOR, Mica, 470 pF ±5%, 500 V
	A2C49		100171	DM15-470J	72136	CAPACITOR, Mica, 47 pF ±5%, 500 V
	A2C51	B	100179	DM15-560J	72136	CAPACITOR, Mica, 56 pF ±5%, 500 V
	A2C58		104147	192P1039R8	56289	CAPACITOR, Mylar, .01 μF ±10%, 80 V
	A2C71		100068	DM15ED220J	72136	CAPACITOR, Mica, 22 pF ±5%, 500 V
	A2C81		104134	CSR13F226K1	31433	CAPACITOR, Tantalum, 22 μF ±20%, 35 V
	A2C85		104136	DM15-050K	72136	CAPACITOR, Mica, 5 pF ±10%, 500 V
	A2C88					Not used
	A2C93		104147	192P1039R8	56289	CAPACITOR, Mylar, .01 μF ±10%, 80 V
	A2D28		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A2D29		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A2D30		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A2D31		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A2D39					Jumper Wire
	A2D40		100421	1N4734A	04713	DIODE, Zener, 5.6 V ±10%, 1 W
	A2D41		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A2D42		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A2D61		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A2D77		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A2D86		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A2D87		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A2D89		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A2D90		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A2D94		100440	1N4830	03508	DIODE, Signal, 20 PIV (2.69 V Fwd)
	A2D95		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A2D96		105532	1N4446	03494	DIODE, Silicon, 75 PIV
	A2Q32		105652	2N2102	18714	TRANSISTOR, NPN Silicon, TO-5
	A2Q33		105652	2N2102	18714	TRANSISTOR, NPN Silicon, TO-5
	A2Q34		105673	2N5087	04713	TRANSISTOR, PNP Silicon, TO-92
	A2Q35		105673	2N5087	04714	TRANSISTOR, PNP Silicon, TO-92
	A2Q36		105652	2N2102	18714	TRANSISTOR, NPN Silicon, TO-5
	A2Q37		105673	2N5087	04713	TRANSISTOR, PNP Silicon, TO-92
	A2Q38		105652	2N2102	18714	TRANSISTOR, NPN Silicon, TO-5
	A2Q60		105659	2N4045	22229	TRANSISTOR, Dual NPN Silicon, TO-5
	A2Q62		105673	2N5087	04713	TRANSISTOR, PNP Silicon, TO-92
	A2Q63		105673	2N5087	04713	TRANSISTOR, PNP Silicon, TO-92
	A2Q64		105652	2N2102	18714	TRANSISTOR, NPN Silicon, TO-5
	A2Q97		105652	2N2012	18714	TRANSISTOR, NPN Silicon, TO-5
	A2R1	B	104846	RL07S242G	14674	RESISTOR, Metal Film, 2400 Ω ±2%, 1/4 W
	A2R2		104861	RL07S103G	14674	RESISTOR, Metal Film, 10 kΩ ±2%, 1/4 W
	A2R3		104849	RL07S332G	14674	RESISTOR, Metal Film, 3300 Ω ±2%, 1/4 W
	A2R4		108579	RL07S752G	14674	RESISTOR, Metal Film, 7500 Ω ±2%, 1/4 W
	A2R5		104885	RL07S104G	14674	RESISTOR, Metal Film, 100 kΩ ±2%, 1/4 W
	A2R6		104873	RL07S333G	14674	RESISTOR, Metal Film, 33 kΩ ±2%, 1/4 W
	A2R7	T				RESISTOR, Value Selected at Test
	A2R8	T				RESISTOR, Value Selected at Test
	A2R9		104827	RL07S391G	14674	RESISTOR, Metal Film, 390 Ω ±2%, 1/4 W
	A2R10		104861	RL07S103G	14674	RESISTOR, Metal Film, 10 kΩ ±2%, 1/4 W
	A2R11		105449			RESISTOR, Wirewound, 500 Ω ±5%, 5 W
	A2R12		104875	RL07S393G	14674	RESISTOR, Metal Film, 39 kΩ ±2%, 1/4 W
	A2R13		104878	RL07S513G	14674	RESISTOR, Metal Film, 51 kΩ ±2%, 1/4 W
	A2R14		104885	RL07S104G	14674	RESISTOR, Metal Film, 100 kΩ ±2%, 1/4 W
	A2R15		104885	RL07S104G	14674	RESISTOR, Metal Film, 100 kΩ ±2%, 1/4 W
	A2R16		104873	RL07S333G	14674	RESISTOR, Metal Film, 33 kΩ ±2%, 1/4 W
	A2R17		104856	RL07S622G	14674	RESISTOR, Metal Film, 6200 Ω ±2%, 1/4 W
	A2R18		104878	RL07S513G	14674	RESISTOR, Metal Film, 51 kΩ ±2%, 1/4 W
	A2R19		104972	RCR07G105KS	01121	RESISTOR, Carbon, 1 MΩ ±10%, 1/4 W
	A2R20		104861	RL07S103G	14674	RESISTOR, Metal Film, 10 kΩ ±2%, 1/4 W
	A2R21		104837	RL07S102K	14674	RESISTOR, Metal Film, 1000 Ω ±2%, 1/4 W
	A2R22		104861	RL07S103G	14674	RESISTOR, Metal Film, 10 kΩ ±2%, 1/4 W
	A2R23		104861	RL07S103G	14674	RESISTOR, Metal Film, 10 kΩ ±2%, 1/4 W
	A2R24		104861	RL07S103G	14674	RESISTOR, Metal Film, 10 kΩ ±2%, 1/4 W
	A2R27		104865	RL07S153G	14674	RESISTOR, Metal Film, 15 kΩ ±2%, 1/4 W

Table 9-2. Leveler Printed Circuit Board Assembly A2 Parts List (Continued)

FIG. NO. / ITEM NO.	REF. DESIG.	USE CODE	SYSTRON-DONNER PART NUMBER	MFR. PART NO.	MFR. CODE	DESCRIPTION
	A2R43		104858	RL07S752G	14674	RESISTOR, Metal Film, 7500 Ω ±2%, 1/4 W
	A2R46		104854	RL07S512G	14674	RESISTOR, Metal Film, 5100 Ω ±2%, 1/4 W
	A2R48		104837	RL07S102G	14674	RESISTOR, Metal Film, 1000 Ω ±2%, 1/4 W
	A2R50		104837	RL07S102G	14674	RESISTOR, Metal Film, 1000 Ω ±2%, 1/4 W
	A2R52		104853	RL07S472G	14674	RESISTOR, Metal Film, 4700 Ω ±2%, 1/4 W
	A2R53		104889	RL07S154G	14674	RESISTOR, Metal Film, 150 kΩ ±2%, 1/4 W
	A2R54		104889	RL07S154G	14674	RESISTOR, Metal Film, 150 kΩ ±2%, 1/4 W
	A2R55		104885	RL07S104G	14674	RESISTOR, Metal Film, 100 kΩ ±2%, 1/4 W
	A2R56					Not used
	A2R57		104885	RL07S104G	14674	RESISTOR, Metal Film, 100 kΩ ±2%, 1/4 W
	A2R59		104806	RL07S510G	14674	RESISTOR, Metal Film, 51 Ω ±2%, 1/4 W
	A2R65		104837	RL07S102G	14674	RESISTOR, Metal Film, 1000 Ω ±2%, 1/4 W
	A2R66		104823	RL07S271G	14674	RESISTOR, Metal Film, 270 Ω ±2%, 1/4 W
	A2R67	T				RESISTOR, Value Selected at Test
	A2R68		104839	RL07S122G	14674	RESISTOR, Metal Film, 1200 Ω ±2%, 1/4 W
	A2R69		104974	RCR07G225KS	01221	RESISTOR, Carbon, 2.2 MΩ ±10%, 1/4 W
	A2R72		105421	3X300	63743	RESISTOR, Wirewound, 300 Ω ±5%, 3 W
	A2R74		104889	RL07S154G	14674	RESISTOR, Metal Film, 150 kΩ ±2%, 1/4 W
	A2R75	B				RESISTOR, Metal Film
	A2R79		104849	RL07S332G	14674	RESISTOR, Metal Film, 3300 Ω ±2%, 1/4 W
	A2R80		104861	RL07S103G	14674	RESISTOR, Metal Film, 10 kΩ ±2%, 1/4 W
	A2R82		104923		01121	RESISTOR, Carbon, 5.1 Ω ±5%, 1/4 W
	A2R83	T				RESISTOR, Value Selected at Test
	A2R84	T				RESISTOR, Value Selected at Test
	A2R91		104853	RL07S472G	14674	RESISTOR, Metal Film, 4700 Ω ±2%, 1/4 W
	A2R92		104853	RL07S472G	14674	RESISTOR, Metal Film, 4700 Ω ±2%, 1/4 W
			100766	TXBF632-025B	98978	HEATSINK, Transistor, TO-5
			105619	BHS-5-TO5	71002	PAD, Transistor, TO-5
			936033		01220	BOARD, Printed Circuit

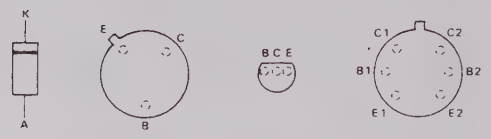


NOTES: 1. SYMBOL * INDICATES COMPONENT VALUE SELECTED AT TEST.

2. SYMBOL † INDICATES COMPONENT VALUE OR PRESENCE DETERMINED BY RF PLUG-IN MODEL: REFER TO TABLE 8-2.

Figure 9-2. Leveler Printed Circuit Board Assembly A2 Parts Location/Schematic Diagram

VIEWS FROM TOP OF SEMICONDUCTOR DEVICE



ALL DIODES | Q32, Q33, Q36, Q38, Q64, Q97 | Q34, Q35, Q37, Q62, Q63 | Q60

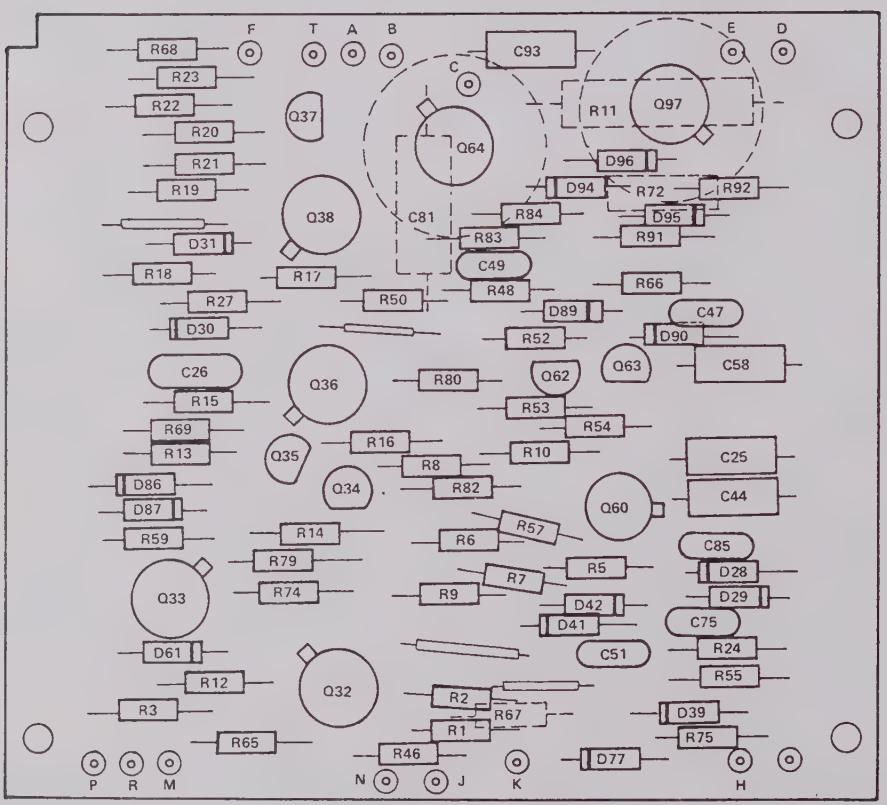
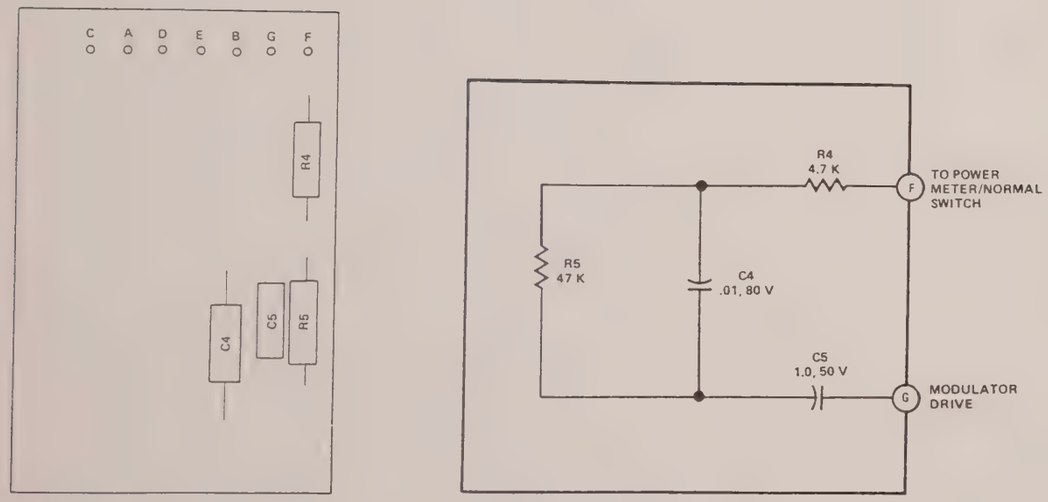


Table 9-3. Power Meter Leveling Assembly A3 (Option M7) Parts List

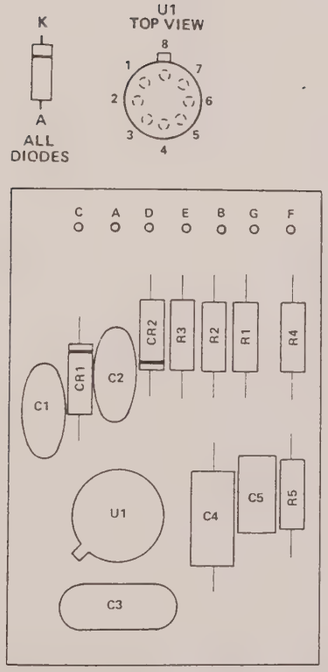
FIG. NO. / ITEM NO.	REF. DESIG.	USE CODE	SYSTRON-DONNER PART NUMBER	MFR. PART NO.	MFR. CODE	DESCRIPTION
9-3	A3	M7	95060501		01220	BOARD ASSY – POWER METER LEVELING Consisting of:
	A3C1					Not used
	A3C2					Not used
	A3C3					Not used
	A3C4		104147	192P1039R8	56289	CAPACITOR, Mylar, 0.01 μF ±10%, 80 V
	A3C5		107627	3420-050E105M	00656	CAPACITOR, Ceramic, 1.0 μF ±20%, 50 V
	A3R1					Not used
	A3R2					Not used
	A3R3					Not used
	A3R4		104853	RL07S472G	14674	RESISTOR, Metal Film, 4700 Ω ±2%, 1/4 W
	A3R5		104877	RL07S473G	14674	RESISTOR, Metal Film, 47 kΩ ±2%, 1/4 W
	–					
			936276		01220	BOARD, Printed Circuit

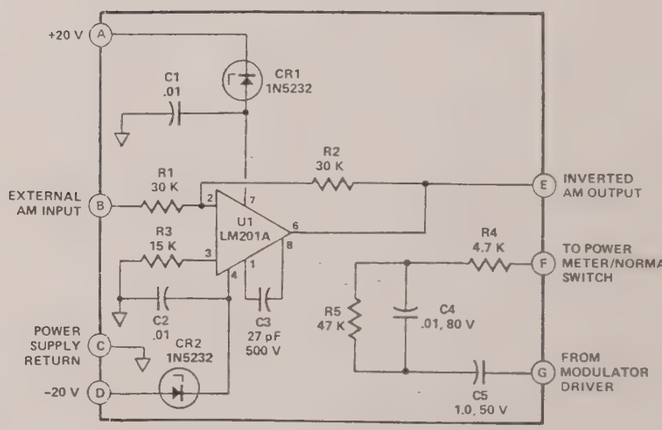
Table 9-4. Power Meter Leveling Assembly A3 (Option M7A) Parts List

FIG. NO. / ITEM NO.	REF. DESIG.	USE CODE	SYSTRON-DONNER PART NUMBER	MFR. PART NO.	MFR. CODE	DESCRIPTION
9-3	A3	M7A	95060502		01220	BOARD ASSY – POWER METER LEVELING Consisting of:
	A3C1		100103	TA110	91418	CAPACITOR, Ceramic, 0.01 μF +80%, –20%, 100 V
	A3C2		100103	TA110	91418	CAPACITOR, Ceramic, 0.01 μF +80%, –20%, 100 V
	A3C3		102545	DM15ED270J0	72136	CAPACITOR, Mica, 27 pF ±5%, 500 V
	A3C4		104147	192P1039R8	56289	CAPACITOR, Mylar, 0.01 μF ±10%, 80 V
	A3C5		107627	3420-050E105M	00656	CAPACITOR, Ceramic, 1.0 μF ±20%, 50 V
	A3CR1		105563	1N5232	04713	DIODE, Zener, 5.6 V ±10%, 1/2 W
	A3CR2		105563	1N5232	04713	DIODE, Zener, 5.6 V ±10%, 1/2 W
	A3R1		104872	RL07S303G	14674	RESISTOR, Metal Film, 30 kΩ ±2%, 1/4 W
	A3R2		104872	RL07S303G	14674	RESISTOR, Metal Film, 30 kΩ ±2%, 1/4 W
	A3R3		104865	RL07S153G	14674	RESISTOR, Metal Film, 15 kΩ ±2%, 1/4 W
	A3R4		104853	RL07S472G	14674	RESISTOR, Metal Film, 4700 Ω ±2%, 1/4 W
	A3R5		104877	RL07S473G	14674	RESISTOR, Metal Film, 47 kΩ ±2%, 1/4 W
	A3U1		105616	LM201AH	04713	INTEGRATED CIRCUIT, Operational Amplifier, TO-5
			936276		01220	BOARD, Printed Circuit



A3 OPTION M7 NEGATIVE POWER METER LEVELING ASSEMBLY 95060501





A3 OPTION M7A POSITIVE POWER METER LEVELING ASSEMBLY 95060502

Figure 9-3. Power Meter Leveling Assembly A3 Parts Location/Schematic Diagram

Table 9-5. Fast A.M. Assembly A4 (Option M3/M3A) Parts List

FIG. NO. / ITEM NO.	REF. DESIG.	USE CODE	SYSTRON-DONNER PART NUMBER	MFR. PART NO.	MFR. CODE	DESCRIPTION
9-4	A4	M3/M3A	95023101		01220	BOARD ASSY – FAST A.M. Consisting of:
	A4C301		104147	192P1039RS	56280	CAPACITOR, Mylar, 0.01 μF ±10%, 80 V
	A4R301					Not used
	A4R302		104813	RL07S101G	14674	RESISTOR, Metal Film, 100 Ω ±2%, 1/4 W
	A4R303		104813	RL07S101G	14674	RESISTOR, Metal Film, 100 Ω ±2%, 1/4 W
			936187		01220	BOARD, Printed Circuit

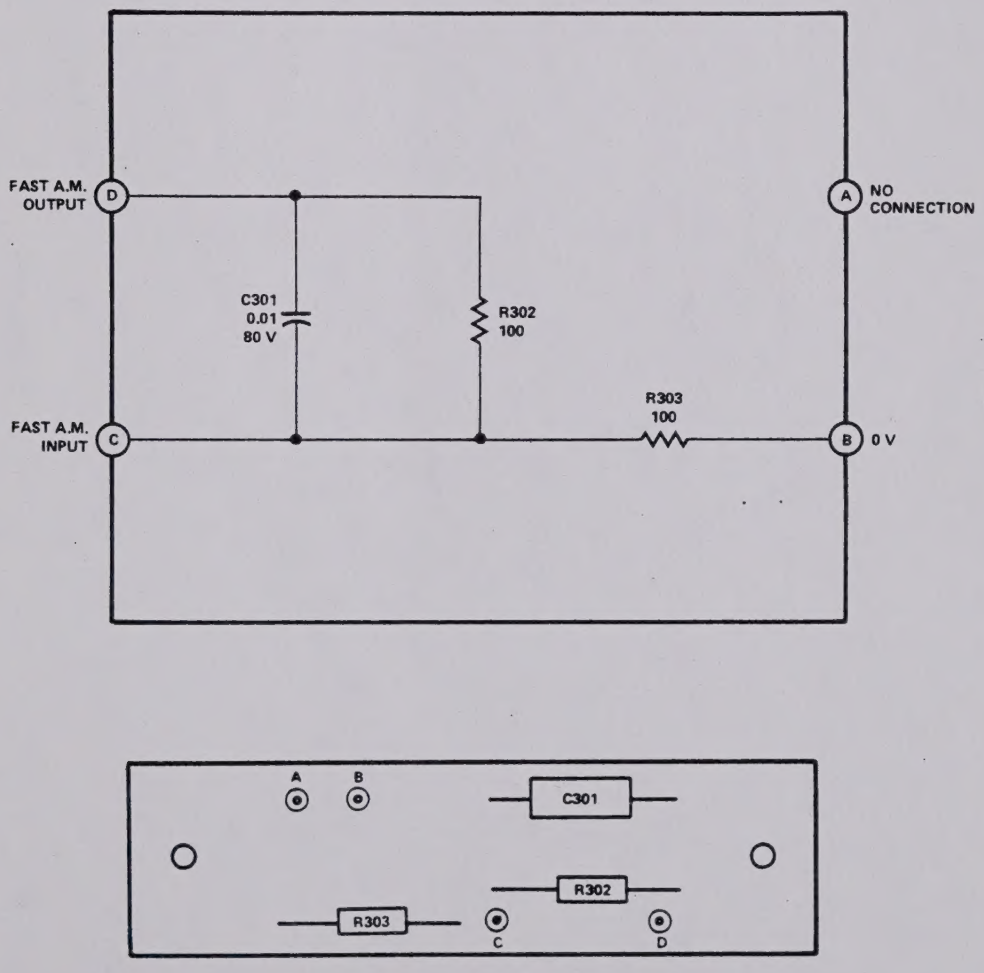


Figure 9-4. Fast A.M. Assembly A4 Parts Location/Schematic Diagram

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